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THE EFFECT OF PROTECTIVE EQUIPMENT ON THE ACTUAL AND PERCEIVED BODY-SPACE RELATIONSHIP OF ICE HOCKEY GOALERS AGED EIGHT TO FOURTEEN YEARS

by

ⓒ JEAN L. WILLIAMS

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

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FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled, "The Effect of Protective Equipment on the Actual and Perceived Body-Space Relationship of Ice Hockey Goalers aged Eight to Fourteen Years," submitted by Jean L. Williams in partial fulfilment of the requirements for the degree of Master of Arts.

ABSTRACT

The purpose of this study was to determine the effect of heavy equipment on the perception of body size. Ice hockey goal-tenders were chosen as subjects because they frequently undertake strenuous activity in heavy protective clothing in a confined spatial context. The problem was to measure goalers' perception of their body size, their perception of goal size and the area of the goal blocked by the body. Three groups of subjects were tested at ages ten, twelve and fourteen years.

Three tests were designed to measure these factors. The Self Image Perception Test (SIPT) measured the sizes of body parts and the total body area as perceived by the goaler in full equipment. The goal construction task measured the difference between perceived body size, with and without equipment, in relation to the perceived height and width of the goal. The blocking device measured the area of the goal the goaler thinks he blocks with his body.

Perceived size was compared to the actual size. Actual size was obtained by photographing each subject in a standard goal, with and without equipment.

Results relating perceived size to actual size, body size to goal size and the effect of equipment and no equipment were compared. Differences in scores due to the variation in the age of subjects was noted.

It was concluded that:-

1. Goalers frequently do not make a realistic assessment of the relation between their body size and the goal size.
2. Goalers make an accurate judgment of the dimensions of the goal, so any misjudgment of body/goal spatial relationships will probably be due to their perception of their own body size.
3. A goaler's estimate of his body size appears to be related to a total body image rather than any form of visual or mirror image he may have.
4. Somatic and spatial perception can be affected by the wearing of heavy protective equipment.

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CHAPTER I

STATEMENT OF THE PROBLEM

Introduction

This study is an enquiry into one aspect of goal-keeping behavior. The goal-keeper is the last player in the line of defence in most field games. There is a certain amount of ritual attached to his position. He often finds himself alone, a symbolic figure, the only remaining player who can stop the opposition from reaching the ultimate prize of the game--the scoring of the goal. As in all ritual, the ceremonial clothing, the movement about a confined space and prescribed area are fundamental concerns. The goal-keeper in his isolated position receives special consideration and respect from other players. While in his crease he is protected from physical contact and may be allowed special privileges. He is conspicuous for non-participation in the skirmishes which all too often break out during the game. He assumes a somewhat elevated and aloof position.

Specifications of a goal-keeper's task have basic similarities in many games. Primarily, he has an area of fixed dimensions to defend. He must not allow the opposing side to penetrate this area. It is therefore necessary for him to be familiar with his goal space and confident in his ability to protect it. The skill and style of the goal-keeper reflects his judgment of the task. This in turn is

dependent on his estimate of the space in which he operates. It is in this context that the relationship of his own body size to the goal size becomes important.

At any given moment, the area of concern to the goal-keeper is that space which is not already blocked by his body; the _de facto_ assumption being that a goal cannot be scored through the area covered by the body of the goal-keeper. The accuracy of his perception of the unblocked area is crucial to his success. It depends on his perception of three factors; his own body size, the goal size, and the relationship between the two. The veridicality of his perception is gauged by the identity of his perceived size with his actual size or the difference between the two.

In several games, the goal-keeper is provided with protective equipment and blocking instruments which add considerably to his actual size. This, added to the extra weight and impediment to the freedom of movement, must affect the goal-keeper's perception of the general situation and his part in it. The possible perceptual biases and deviations resulting from being covered in a layer of padding could affect goal-keeping behavior, and the acquiring of necessary skills.

Ice hockey goalies may be particularly vulnerable to perceptual distortion. Never since medieval knights prepared for jousting, have sportsmen been protected by so much equipment. They are virtually covered from head to foot in heavily padded clothing. Even the mask resembles the knight

in his helmet and visor, protecting the head, but obscuring vision. If body perception is affected by clothing a study of ice hockey goalies should provide some evidence.

The goal-keeper in ice hockey is perhaps unique in that his protective armor must serve more than one purpose. Besides protecting him from direct projectile injuries the padding must insulate him from sub-zero temperatures. Further it must prevent injury from sharpened metal skate blades, wooden sticks and errant body parts of other players. Finally it must also protect the goaler from potentially injurious falls backwards as well as forwards. While ice at or above freezing may become spongy, at zero degrees Fahrenheit ($0^{o}F$) and colder it is extremely hard.

The goal-tender in ice hockey is provided with a range of very expensive and effective equipment. It consists of leg-pads, belly-pad, shoulder-pads, arm-pads, padded shorts, heavy gloves, mask and skates. The leg-pads provide a massive, invulnerable wall, behind which, in his goaler's stance, the goal-keeper often seems to disappear. This equipment is so cumbersome that one of the easiest ways to dress a goaler is to put him into the pads. The pads are placed on the floor, the goaler lies face down on top of them, while attendants strap him in.

Every item of equipment is designed to provide the maximum amount of protection for the body. It must also combine the largest possible blocking size with the flexibility necessary for movement (See Figure 1). The gloves

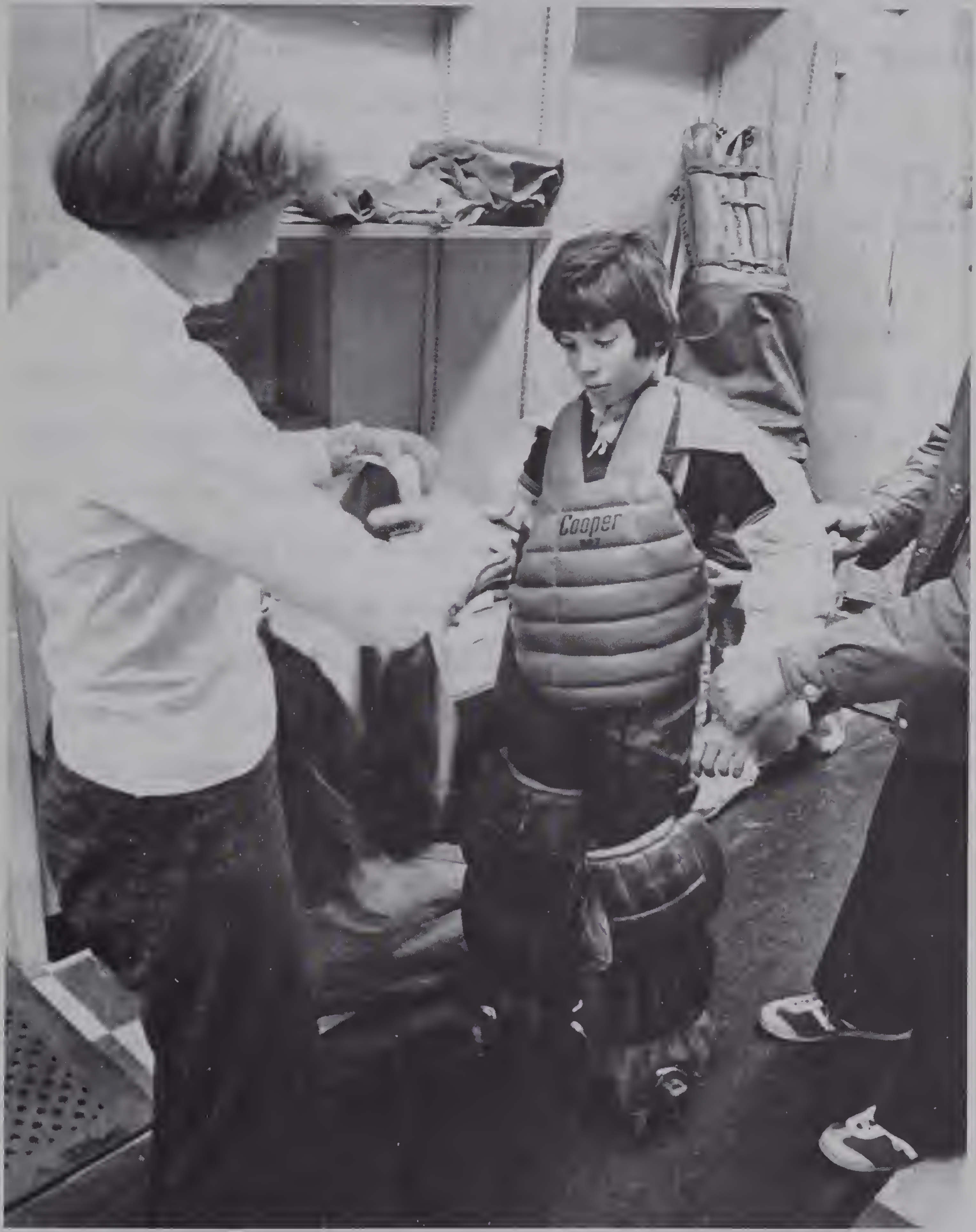


FIGURE 1.0

A GOALER DONS GOAL-TENDING EQUIPMENT

[illegible]

[illegible]

in particular fulfil this intention. The stick glove is heavily padded, large and rectangular. It is used to protect the back side of the players' hand and arm. A flexible leather glove on the underside allows the stick to be grasped and manoeuvred. The 'catching' glove is a large, well-padded gauntlet shaped to hold the puck when the goaler reaches for a shot high off the ground.

The mask, or cage, protects the goal-keeper from facial injuries. The purpose of the mask is to spread the impact forces over the whole face. Although at no time can the resulting shock be disregarded, it is not so uncomfortable as to give rise to an avoidance response. The head, enclosed by the cage or mask, thus becomes part of the goaler in the sheer physical blocking of the net. The skates also contribute to the body blocking area by increasing the height of the goaler. At the same time they are equipped with teeth which prevent the puck from passing between skate blade and boot.

The total blocking or space-filling area of the fully clad goal-keeper is completed by the goal stick. It comes in various sizes, lays (angle of handle to blade), and weights. There is a maximum set of dimensions allowed by the rules, as there are for all pieces of goal-tending equipment, and these are taken into account when choosing pieces appropriate to the height, weight, strength and maturity of the goal-keeper.

In this almost complete armor the goaler moves into

his prescribed area. Ice hockey rules allow any and every part of the body and stick to be used in the defence of the goal-area. Therefore the body in its total array is the appropriate unit of measurement when analysing the task requirements of the goal-tender's assignment.

Several fundamental body/environment relationships inherent in the goal-keeper's task must be considered before any further analysis of goaling behavior or associated skills is attempted. The basic factor is the area of the space to be guarded related to the proportion of that space occupied by the body of the goal-keeper. This is the problem facing the opposing side, who seek to penetrate the space that is left unguarded at a given moment. It is essential that the goal-tender should have an accurate assessment of what the opposition sees. If he is to be in the area of the highest scoring incidence at the right moment, he must have a realistic conception of the space he is guarding. This implies a knowledge of both the goal space and of the space he is occupying within the goal area.

The present study is subsumed under a major survey directed by Dr. R. B. Wilberg at the University of Alberta. The University awarded grant #5532610 for a normative survey of goal-keepers who regularly play for teams in the Edmonton Metropolitan Hockey Association. There are more than eight hundred boys playing in goal whose ages range from 8-18 years. The aim of the survey is to establish norms relating to the size goal-tenders actually are in relation to the

goal, and the size they perceive themselves to be. The survey consists in the recording of the actual and perceived size of the goal-tender, both when wearing equipment and without equipment. Norms will eventually be established for each age level from this evidence.

The Problem

The purpose of the study was to: a) determine the effect of wearing heavy goal-tending equipment on perception of body size; and b) relate the evidence gained concerning perceived body size to the evidence of actual body size yielded by the major survey.

The specific objectives of the study are formulated in the following questions:-

1. What is the range of distortion of the size of body parts in relation to the standard size as shown by the SIPT test? (Gottesman and Caldwell 1966).
2. Do the scores showing distortion cluster round certain body parts? (Gunvald 1951).
3. Is there a difference between a goaler's perceived body size and his actual body size when wearing goal-tending equipment? (Dillon 1962).
4. Is there a difference between a goaler's perceived body size and his actual body size when wearing minimal clothing?
5. Does the goaler overestimate the size and blocking area of the equipment?

6. Is there a greater percentage error score for perception of body size when estimates are related to the wearing of equipment than when they relate to the wearing of minimal clothing?
7. Is there a difference between the actual height and width of the goal and the height and width the goaler perceives it to be: a) with equipment on, b) when wearing T-shirt and shorts?
8. Is there a difference in the area of the goal-net the goaler actually covers and the area he thinks he covers: a) with equipment on, b) when wearing T-shirt and shorts?
9. Does a difference in age affect the estimate of the goal area blocked by the body? (Nash and Harris 1970).
10. Does the amount and range of distortion vary with age? (Werner and Wapner 1962).

Body Image and Body Size

Perceived body size is subsumed under the body percept, which is a contributory factor in body image. (Gorman 1969, Werner and Wapner 1962). Schilder (1935), who first posited the notion of body image, described it as the impression each person has of his own body. It is a self-appearance of the body which is both a perception and a representation. He defined it as a dynamic composite image "in perpetual inner self-construction," formed from

past events and present experiences. Witkin (1962) suggests the image contains cognitive, affective, conscious and unconscious factors relating to one's own body and to the bodies of others. Cultural and emotional pressures and social norms affect the normal development of body image (Fisher and Cleveland 1958). Its function is to record and control postural and motor coordinations and its normal development is crucial to personality and maturity (Nash 1970).

The task of clarifying the meaning of the term body image, though begun, is far from complete. This partly due to the ever-changing flexibility which the literature suggests characterizes body image. It varies from one activity to another and from one spatial location to another. Body image, or the awareness of one's own body, dissolves in sleep (Schilder 1935), is destroyed in illness (Critchley 1953) and may be temporarily distorted by drugs (Wapner and Krus 1960).

Clothing and tools, for example the stick of the blind man or the scalpel of the surgeon, become blended into the body image (McFarland, Clarkson, Wapner and Werner 1960). Even the space surrounding the individual, "the body buffer zone" becomes part of the image. This area which is private, is invaded by others to the discomfort and anxiety of the person concerned (Schlacter 1970).

So far, the work on body image, stemming from Schilder's (1935) basic ideas has named and defined some of

its facets. There has been a volume of work based on the body barrier construct of Fisher and Cleveland (1958), which relates to body image and personality. Witkin _et al_ (1954) established the notion of body concept, which was concerned with cognitive aspects of the body image.

Werner and Wapner (1962) have defined and begun to measure body percept, including perceived body size. Nash (1951) was the first to work on estimates of distances on the body. Shontz (1963-64-67) and Dillon (1962) have studied the estimation of body size including estimates of sizes of body parts, limbs and the whole body. This study is an extension of the work relating to perceived body size, which will be related to actual body size. The effect of clothing on body perception will also be considered.

Flugel (1930) refers to changes in body image brought about by the use of clothing, cosmetics and other aids. Clothes are also used as an identifying medium, and at carnival times as a means of concealing identity. The function of clothing as a protection and as a decoration is well known. Clothing is often used intentionally to disguise or accentuate certain body parts and in sports to protect body areas. Compton (1966) showed the effect of clothing on body boundary and Hamid (1969) reports the effect of clothing on judgements of personality and attractiveness. No systematic study has been made of the effects of clothing on the perception of body size.

Importance of this Study

This study is important because the data yields empirical evidence of factors impinging on body image which have not yet been documented. It is predicted that there will be a difference between actual body size and perceived body size and that this will be exaggerated by the wearing of heavy goal-tending equipment. If the discrepancies are clearly demonstrated, any consideration of coaching methods should be affected. If the differences are further emphasized at different age levels, or according to the actual size of the goaler (according to height and weight), a variation of coaching methods at the separate age levels may be indicated. Any discrepancy between the area of the goal actually covered by the goaler and that he thinks he covers, points to the need for a reassessment of the nature of the skills involved: for the first principle of skilled performance is an accurate definition of the task. The study also, through application of its findings, implies a need for further work relating to the effect of body perception of heavy equipment in other professional and industrial occupations.

Delimitations

The study was limited to goalers who played regularly for Edmonton Metropolitan Hockey Association during the season 1973-74. Subjects aged 10 years and under, 12 years and under, and 14 years and under were tested.

Limitations

The sample used in this investigation comprised approximately fifty per cent of the total number of age group goalers to eventually be tested. Subjects participated on a voluntary basis.

Definition of Terms

Body image. "The image of the human body means the picture of our body which we form in our mind, that is to say the way in which our body appears to ourselves." (Schilder 1935).

Body percept. The visual, tactile and kinaesthetic perceptions of the body experience in relation to environmental and spatial conditions. (Werner and Wapner 1962).

Body concept. The cognitive aspect of the "systematic impression an individual has of his body, cognitive and affective, conscious and unconscious, formed in the process of growing up." (Witkin 1962). Body concept may be expressed verbally, or symbolically in drawing (Bennett 1960). It guides the perception of the body (Witkin 1962).

Body parts. The body parts referred to in the SIPT were the head, masked; the stick hand, gloved; the catching hand, gloved; the legs, padded; and the stick.

SIPT. The Self-Image Perception Test.

Goal-tending equipment. Subjects were required to wear as a full complement:- skates, hockey shorts, shoulder and arm pads, belly-pads, team sweater, goal-pads, mask

and stick.

Size. Area of cartographical representations of the body yielded by the photographs and the perception tests. The areas were computed in square centimeters. The size was in relation to a life size (4' x 6' or 122 x 183 cm) goal.

Success. The measure of the goaler's wins/losses record and the goals against average.

Distortion. Percentage deviation from the standard size in either a positive or negative direction.

CHAPTER II

RELATED LITERATURE

Perception of body size has been defined in Chapter I as a delimitation, and therefore contributing factor, to body image. The literature relating to the area of body image centers round four main themes: body image, body schema, body percept and body concept. Body image refers to a global awareness of the sum of body experience as it is present to a particular person at a particular time. Body schema is the term used for the physiological correlates of body image in the central nervous system. Body percept is a psychological construct combining two factors: information gained from the sensory apparatus relating to the body, and the organization of the information into a representation of reality. Body concept refers to the cognitive awareness of one's own body which the person can describe in words or represent in drawings. Perception of body size is one aspect of the body percept, which in turn founds body image.

Body Image

The term "body image" was first used by Paul Schilder when he published his book The Image and Appearance of the Human Body in 1935. This book was an elaboration of an earlier paper, "Korperschema" from which the term obviously stems. Schilder, writing from a background of clinical and

psychiatric experience, emphasizes the composite and indivisible nature of body image. He writes:-

> It would be erroneous to suppose that phenomenology and psycho-analysis should or could be separated from brain pathology. It seems to me that the theory of organism should be incorporated in a psychological doctrine which sees life and personality as a unit.

Phenomenology implies the notion of the "lived body", the body as it is subjectively experienced. Psychoanalysis suggests a sub-conscious influence exerted by the body on personality. Psychology assumes a scientific analysis of mind, particularly in its capacity for organizing perception and behaviors. Schilder (1935) thus sees the term body image as including conscious, unconscious and perceptual awareness as well as cognitive processes. It therefore straddles disciplines traditionally kept separate by philosophy and science, uniting many points of view concerning the same body.

Body image has not been fully defined, although it has been recognized as important in influencing such developmental factors as self-concept (John Nash 1970), personality (Fisher and Cleveland 1958), and psychological maturity (Witkin *et al* 1962). The development of body image, in the form of body awareness, has been listed as an educational aim by Morison (1969) and Preston (1963).

It is evident in everyday tasks as an awareness of the body as a medium of contact with people and objects. The individual perceives his body as a "halo" surrounding his action (Ricoeur 1966) which becomes distinct only when,

through pain or effort, the body becomes central to attention. The "tri-dimensional image" (Schilder 1935) thus varies in intensity. It is a dynamic construct formed from a composite of body experiences, past and present, internal and external, cognitive and affective, conscious and unconscious, individual and interpersonal (Ajuriaguerra 1962). It is subject to continuous change; it disappears in sleep (Schilder 1935), is distorted by drugs (Wapner and Krus 1960), is broken by disease (Critchley 1953) and becomes unstable through sensory deprivation (Held 1961). Body image is concerned with the body as it is experienced, not merely as it is known as an object of study or as viewed in the mirror (Brown 1943). The mirror image of the body is not well-known. Few people recognize pictures of their own hands (Van den Berg 1952) or of their own bodies (Deno 1953) and they consistently fail to judge their own size accurately (Shontz 1963-64-67).

Smythies (1953) sees the body image as a visual or mental image or memory of a human body, which may be one's own or that of another. Schilder (1935) suggests that mental images of bodies survive in the emotional and affective context in which they were experienced. Body image, therefore, contains attitudes and feelings concerning the body. Kenyon (1968) and Secord and Jourard (1953) have explored these aspects and developed scales of body esteem and body cathexis. These feelings of like or dislike for one's body becomes particularly important, as Sarte (1956)

comments, when the individual realizes himself as he is seen and known by others.

Body image is described as a complex construct which may be more clearly understood by separate discussion of some of its main adjuncts. As Schilder (1935) states at the beginning of his text, the image is grounded in the body schema, on which it is dependent and through which it operates.

Body Schema

Head (1920) described the body schema as a structure composed of networks of nerve fibers which relay sensory information to the brain relating to body position and movement. The brain stores the information in the form of a dynamic diagram of the body, a "storehouse of past impressions". This is used as a standard against which incoming information is measured. Head (1920) emphasizes the unconscious nature of the schema when he says that:

> . . . for this combined standard, against which all subsequent changes of posture are measured before they enter consciousness, we propose the word "schema".

The schema is in continuous physiological process, undergoing persistent modification of structure as new information enters the system. The standard must be continuously flexible, keeping a tally on the state of the organism. Head uses the terms, "spacial schemata" and "postural schemata", referring to separate physiological dispositions which support separate psychological functions.

Bartlett (1967) elaborates the idea of the body

schema as function. He sees it as mediating between the present stimulus and past events as a factor in determining the appropriate response. He stresses the dynamic character of the active process of the construction of schema out sensory material. This material is arranged in levels, moving upwards from sensory data, through affective levels to the conscious level. A full discussion and comparison of the theories of Head and Bartlett can be found in Oldfield and Zangwill (1942).

The schema is confirmed clinically through various types of impairment of body image due to brain damage. This may be due to disease (Critchley 1953) or war injury (Head) and results in forms of agnosia. Various agnosias have been recorded when there has been a disturbance of schemata through brain lesion or where there has been a recovery and regeneration after lesion. Pathological symptoms show a distortion of body image such as an inability to indicate or locate body parts. In some cases one whole side of the body is completely neglected. There is no motor impairment. There is a disjunction between perception, recognition and motor performance. Although the functions may remain separately intact, the integrating factor is lost. This integrating factor is inferred to be the body schema.

In summary, the body schema provides a structure which regulates the sensory and postural mechanisms of the body. Although the control of postural movement may become

voluntary at any given moment, responsibility is normally assumed by the monitoring function of the schemata. Postural changes are recognized after they have occurred.

Superimposed on this background activity is the selective and organizing power of perception. Perceptual mechanisms are concerned with scanning the environment, the identification of sensory cues and the translation of these cues into a coherent representation of reality.

The Body Percept

Underlying the process of "reading" the environment is a prior awareness of inhabiting a body. The body is first known through the task in which it is engaged. Action and movement in the world exist in the form of a "wired-in" ability to function before consciousness arises. Perception emerges from a two way transaction between the body and the environment. The body becomes gradually defined through the space it inhabits, the objects it can or cannot reach and its ability to cope with tasks.

The body percept has been defined by Wapner and Werner (1962) as the "articulateness between body and environment". This body/environment interdependence points to both a unity and a polarity:

> There can be no perception of objects "out there" without a bodily framework, and conversely, we assume there can be no perception of body-as-object without an environmental frame of reference.

Experimental programs concerning the body percept have reflected this dual focus of the body as it is known in its

context and the body as separate from its context. Studies concerning the body as separate from the environment are discussed in the section on body concept. Studies relating to the effect of environmental conditions on body perception are considered below.

Perceived Body Size

The dependence on environmental cues for the orientation of the body and the stability of body perception has been demonstrated by the work of Stratton (1899), who distorted visual cues by means of lenses which reversed the retinal image. Held (1961) confirmed Stratton's findings and developed his methods by a systematic progressive "disarrangement" of sensory cues. These experiments showed that continuous and ordered contact with the objects of the environment is essential for spatial stability. Werner and Wapner (1962) demonstrated the "reciprocal relationship between the organism and the environment" in their experiments on the effect of different spatial conditions on body size and position.

The perception of body size has been studied in relation to different environmental conditions, of confined and open space (Wapner, McFarland and Werner 1962). Estimated size of body parts varies according to the surrounding space. Estimation of head size (Werner, Wapner and Comalli 1957) and arm length increased and decreased according to "open-extended" and "close-confined" spatial contexts. This over-estimation of arm length was increased still further as

the body seems to extend itself into space as it points to distant objects, and is exaggerated yet again when the limb appears to be extended by grasping a stick (Humphries 1959). The tool or implement is experienced as part of the body and estimates of body size increase to include it. This apparent extension is explained as "the image of one's body gradually blending into its surroundings", and therefore the body boundary becomes less definite. Dillon (1962) supports this view with findings concerning estimates of body size made in ascending and descending order; the descending estimates were significantly larger than the ascending ones in which the body image was anchored by the fixed and visible position of the feet on the ground. Schlater (1970) reinforces this view with an interesting result showing that estimation of size varies with the number of trials. Over trials, as the task becomes tedious and the body tired, attention shifts from being task-centered to being body-centered. Estimates correspondingly decrease from pre-test to post-test judgments of body size, as concentration moves inwards from the object to the body itself.

The idea of firm body boundaries (Fisher and Cleveland 1958) has been shown to be important in the accuracy of body size estimates. When body surfaces are touched immediately prior to judgments being made, the estimates are decreased (Werner, Wapner and Comalli 1957). Reitman and Cleveland (1964) confirm this finding, that

increased boundary definiteness reduces perception of size, in their study on the effect of sensory deprivation on body image of schizophrenic and control groups.

Consistent patterns in the estimates of sizes of separate body parts are recorded in the literature. Barton and Wapner (1965) and Shontz (1967) show that components of body parts are consistently overestimated while combinations of parts, such as limbs, tend to be underestimated. Head size is generally exaggerated as in the estimates of head width (Werner, Wapner and Comalli 1957, Shontz 1967), size of head in children's drawings (Nash and Harris 1970) and children's construction of models (Katcher and Levin 1955). Nash (1969) and Shontz (1965) confirm Boraks' (1962) finding that the under-estimation of body size increases from the head downwards, revealing a cephalo-caudal or proximal-distal directionality. Shontz (1967) emphasizes that this configuration is dependent on a particular definition of head size, i.e. head width, for if head length or face height measurements are used over-estimation of head size is not found. Reasons suggested for consistent over-estimation of head size include the notion that the subject is paying more attention to the center of self-hood (Nash and Harris 1970), that the head is the most easily recognizable part of the body and that from which sounds of communication emerge (Nash and Harris 1970) or that the head merges into the environment and is not felt to have clear boundaries (Barton and Wapner 1965, Dillon 1962).

Nash (1969) in his study on the location of landmarks on the body, refers to the under-estimation of the lower trunk and limbs and suggests four possible reasons for this; the infrequent exposure of these parts of the body leads to uncertainty as to their correct location, the taboos associated with the site of the anal, urinary and genital apparatus result in a "psychological distantiation" from the head region, the fact that the waist is regarded as the center of the body (and other objects), and the possibility of distortion by perspective. This last suggestion rests on the fact that when the subject views himself or others, the perspective distortion reduces the retinal image of the lower portions of the body relative to that of the upper portions.

Fisher (1964) comments on the difference in perception of the right and left sides of the body in predominantly right-handed people. The male sex-attributes of strength and size are assigned to the right side of the body which is experienced as larger, more active, and which shows a right-left directionality in GSR (Galvanic Skin Response) recordings.

Estimation of size of body parts is subject to more distortion than estimation of sizes of objects. Shontz (1967) reports that the difference in estimates between components and combinations of body parts was not replicated when subjects were asked to estimate the lengths of corresponding non-body distances. Reitman and Cleveland

(1964) found the judgments of their subjects of non-body objects did not vary in the same way as judgments of body size. Shontz suggests that the "completely integrated unit" of the body will be judged differently from separate non-body objects. There is also the difference between the visual (non-body) and visual plus haptic (body) experience to account for this.

Anxiety and other emotional and affective personality factors may account for distortion of body size. For example Schlachter (1971) hypothesized that perceived body space and perceived personal space (body buffer zone) were related to the need for a protection zone for emotional well-being and that this would increase with the anxiety rating of the individual. Her hypothesis was confirmed. Fisher and Cleveland (1962) write:

> It has been clearly shown at the experimental level that an individual's perception of his body size may be affected by the nature of his attitude toward himself and his body. Studies indicate that an individual's perception of his body size may reflect such variables as his ability to make independent judgments (Epstein 1957), his degree of disorganization (Cleveland _et al_ 1962) his exposure to sensory isolation . . . and his ingestion of a psychotomimetic drug (Liebert, Werner and Wapner 1958). Apparently there is a tendency for body feeling to be translated into body size terms.

Fisher (1964) demonstrated that people who over-estimated their own height scored higher on achievement and dominance scales.

Longitudinal studies by Witkin _et al_ (1964) show that young children have a less clearly articulated body image than adults, and less well defined body boundaries.

This is confirmed by the studies of McFarland, Wapner and Werner (1960) and Barton and Wapner (1962) in which overestimation of body size was increased for younger age groups. In connection with this it should be remembered that the proportion of head size to body size in young children is greater than in adults (Smart and Smart 1967). Gorman and Mundy (1968) could find no evidence that children's actual body dimensions were reflected in their figure drawings.

Estimates of body size have been shown to vary with measuring instruments, the absence or presence of visual feed-back, conditions of illumination and order of visual presentation (Schontz 1965). Many different measuring instruments have been used. The subject has indicated his estimate by giving written estimates (Berkowitz 1969), marking a horizontal rod (Werner _et al_ 1957), by directing the experimenter to correct vertical rods or beams (Barton and Wapner 1965 , Dillon 1962), by drawing measurements on paper or prepared figures (Schlacter 1971) and by assembling two-dimensional representations of body parts (Gunvald 1951).

The introduction of the notion of methods of measurement assumes that the subject is able to define his body concept. A person cannot report what he perceives until and unless he has formed a related concept. In order to say what he perceives he must formulate a symbolic representation, either verbally or visually. He must be able to call the perception to mind in its absence.

The Body Concept

Body concept is the cognitive correlate of body image. "To form a concept it is necessary to abstract, to single out elements apart from their totality of the concrete experience in which they are embedded." (Vygotsky 1962). Body concept requires an abstraction from body image which can be described in language or symbolized in drawing (Bennett 1960). It has access to body image but includes the additional knowledge of the history of a particular body and all that is known and understood about that body through medicine, science and physical education. The body concept would be changed immediately by the loss of a limb though this would not be apparent to body image for some time, as pain may still be felt in the amputated limb. Changes in body image lag behind changes in body concept (Nash 1970).

Witkin *et al* (1962) have defined body concept through their theory of psychological differentiation. The first factor in differentiation determines the way in which, or the degree to which the individual is able to separate his visual, spatial and kinaesthetic judgments from the context in which they take place. The theory is concerned with the dependence or independence a person has of his immediate background for his awareness of body position and action. Experimentally the subject is required to adjust his body position in the absence of veridical visual cues and his deviation from the true is recorded (McFarland, Clarkson and

Wapner 1961). Other experiments involve the readjustment of objects to a true vertical when they are surrounded by a tilted frame or when the shape of the room is distorted. The degree to which the subject is able to dissociate himself (or an object) from the context is said to be the degree of differentiation he has attained. In theory, as a person matures this differentiation becomes more marked. It includes clarification of body boundaries, the separation of the individual from dependence on others and the awareness of individual identity (Witkin _et_ _al_ 1962).

Differentiation also refers to the form of functional relationships between the component parts of the body system. It reflects the individual's awareness of himself as an integrated whole, this integration being internal to the system as well as external. These structural relationships are dependent upon the level of articulation of experience, the ability to order and classify information and to structure an identity which can make sense of the environment. Body concept, thus defined, guides and integrates body perception (Witkin 1962).

Methods of Measurement

Traditionally, the most popular measuring device for inferring body concept has been the Draw-a-person test. The subject is asked to draw a person, and then to draw a person of the other sex. The test was first used by Goodenough (1926) as a measure of non-verbal intelligence. Scoring was based on the theory that children draw what

they know rather than what they see. The score was based on the number of parts present, and their size and relationship.

More recently, Draw-a-person (DAP), has been used to measure body concept. Different rating scales have been used (Machover 1949, Marlens 1962). Berman and Laffal (1953) and Kotkov and Goodman (1953) used it as an indicator of the body image, finding positive correlation between size and shape of subjects and size and shape of their drawings. Apfeldorf and Smith (1966) took photographs of their subjects, asked them to draw frontal views of a human figure of the same sex, and asked other students to match the photographs with the drawings. They did this successfully. Sixty male and female students matched photos and drawings of the same subjects with greater than chance expectancy.

The findings of Silverstein and Robinson (1961) and Gorman and Mundy (1969) do not support this evidence. A detailed analysis of all DAP tests between 1949 and 1957 by Swenson (1957) almost entirely discredits DAP as a measuring instrument. The controversy set in motion by this paper is still not resolved.

In 1951, Gunvald suggested a new technique for the study of body image, which was independent of drawing skill. The testing instrument consists of outline figure drawings or silhouettes which are varied in size and shape. The figures are divided into separate body parts. From these the subject can construct a figure which is most like him-

self as he perceives himself to be, or as he would most like to be. As the separate parts are measurable it is possible to assign a quantitative score to certain aspects of body size. It can measure the relative size and proportion of body parts and the relationship of one figure to another.

Similar tests have been used by Katcher and Levin (1955) with children two to four years old, by Hunt and Weber (1960) with women students, by Gottesman and Caldwell (1966) with teenage normal and deprived boys and girls and by Vivino (1970) with male and female students. The tests are suitable for all age groups and both sexes. Gunvald (1951) reports that girls eight to ten years found the instrument attractive and enjoyed using it.

The form of the tests are all slightly different although the principle is the same. Katcher and Levin (1955) used "triads of schematic body parts" in three sizes; small, medium and large. The parts used were head, torso, arms and legs. Gottesman and Caldwell (1966) used drawings on cards in seven different sizes. They represented both complete bodies and separate parts of head, upper body and lower body. Hunt and Weber (1960) designed a more sophisticated instrument consisting of a book of eighty-four anterior and lateral silhouettes, varying in height and width.

The system was the subject of a dissertation by Gunvald (1951). He designed a standard instrument consisting of different sizes of seven body parts. There were

nine sizes each of arms, bodies, legs, heads, necks, hands and feet. He tested the instrument for validity and reliability. His subjects were girls aged eight to ten years. They selected from the body parts to assemble representations of models. They then constructed representations of themselves. Gunvald concludes:-

> The findings indicate that for most of the body parts there was a significant agreement in the children's reproductions. The majority of the children did perceive accurately the difference among the bodily heights and widths . . . and could represent these differences with the manikin method.

The fact that the parts selected by the girls were closely related to the actual body measurements of living models indicates that the "disassembled manikin" method is a valid one for representing what people see. The method was also supported by test-retest reliabilities (Gunvald 1951). It seems so far, to provide the most accurate measurement of perceived body size yet tried.

Summary

Studies on perceived body size have been concerned with such aspects as estimates of sizes of body parts (Barton and Wapner 1965), estimates of height (Berkowitz 1969) and body form (Kurtz 1966); differences in perception of the sides of the body (Fisher 1960), the effect of age (Nash 1951), sex (Boraks 1962, Calden 1959), affective and personality factors (Ertel 1969) and the effect of spatial context on body size estimates (Wapner, McFarland and Werner 1962).

Katcher and Levin (1955) emphasize the cultural significance of body size. Children are reared on a diet of monsters and giants and distortions of size such as Alice (in Wonderland) and Gulliver (his travels). Increased size is a sign of importance, as seen in medieval paintings, where the important dignitaries are portrayed much larger than the buildings and landscapes. It is also a sign of increased value (Tajfel 1957), increased friendship (Berkowitz 1969) and strength (Ertel 1969). Calden (1959) and Secord and Jourard (1953) record that both sexes wish men's bodies to be large, while they prefer women to be small and petite. Body size obviously has significant meaning for most human beings.

CHAPTER III

METHODS AND PROCEDURES

The aspects of body perception under test were

a) body perception at different age levels;

b) the effect of clothing on perceived size, i.e. body perception in full goal-tending equipment compared to body perception in minimal clothing;

c) the effect of protective equipment on perception of separate body parts;

d) an estimation of the area of the body in relation to the goal area; and

e) the relationship of actual size to perceived size in a specific location, i.e. the goal-net.

Subjects were invited to the Human Performance laboratory at the University of Alberta where a series of activities had been prepared. An interview, a photographic session and three perception tasks were designed to yield measures of actual and perceived size. The interview provided data relating to the age, height and weight of the subject. The photographic session recorded his body size, as it actually is, in relation to the goal size. The series of perception tasks provided evidence of:

a) perceived size of separate body parts;

b) the perceived size of the goal-tender in the net;

c) a comparison of his perceived size in full equipment and in minimal clothing;

d) an estimation of the area of the net blocked by the body.

Apparatus

Goal-tending equipment. S was required to be dressed in full goal-tending equipment for the photographic session. The Ss were encourages to bring the goal-tending equipment they regularly wore during the playing season. If for some reason the equipment could not be obtained, four complete sets of goal-tending equipment were made available to a given S. He then chose the set most like his own and donned it in the usual fashion. The manner and order in which each piece of equipment was donned varied from S to S. Similarly, the Ss displayed considerable variety in the amount and kind of protective padding added or deleted from the required complement (see definitions).

Photographic equipment. A section of the laboratory was set aside as a photographic studio. The set was arranged as in Figure 2. A regular Art Ross goal-net was set up on white hard-board sheeting. A standard goal-crease was marked out on the white surface. Immediately in front of and in contact with the goal, a 6mm C.I.L. polythene drop-sheet was suspended. This was gridded with one inch squares. In front and to the side of the goal cage a small information board was placed on which personal details from the data sheet (see Appendix A) were recorded. A 35mm Canon camera, with electronic flash, was mounted on a tripod stand fifteen feet away from the net. It was loaded with 35mm

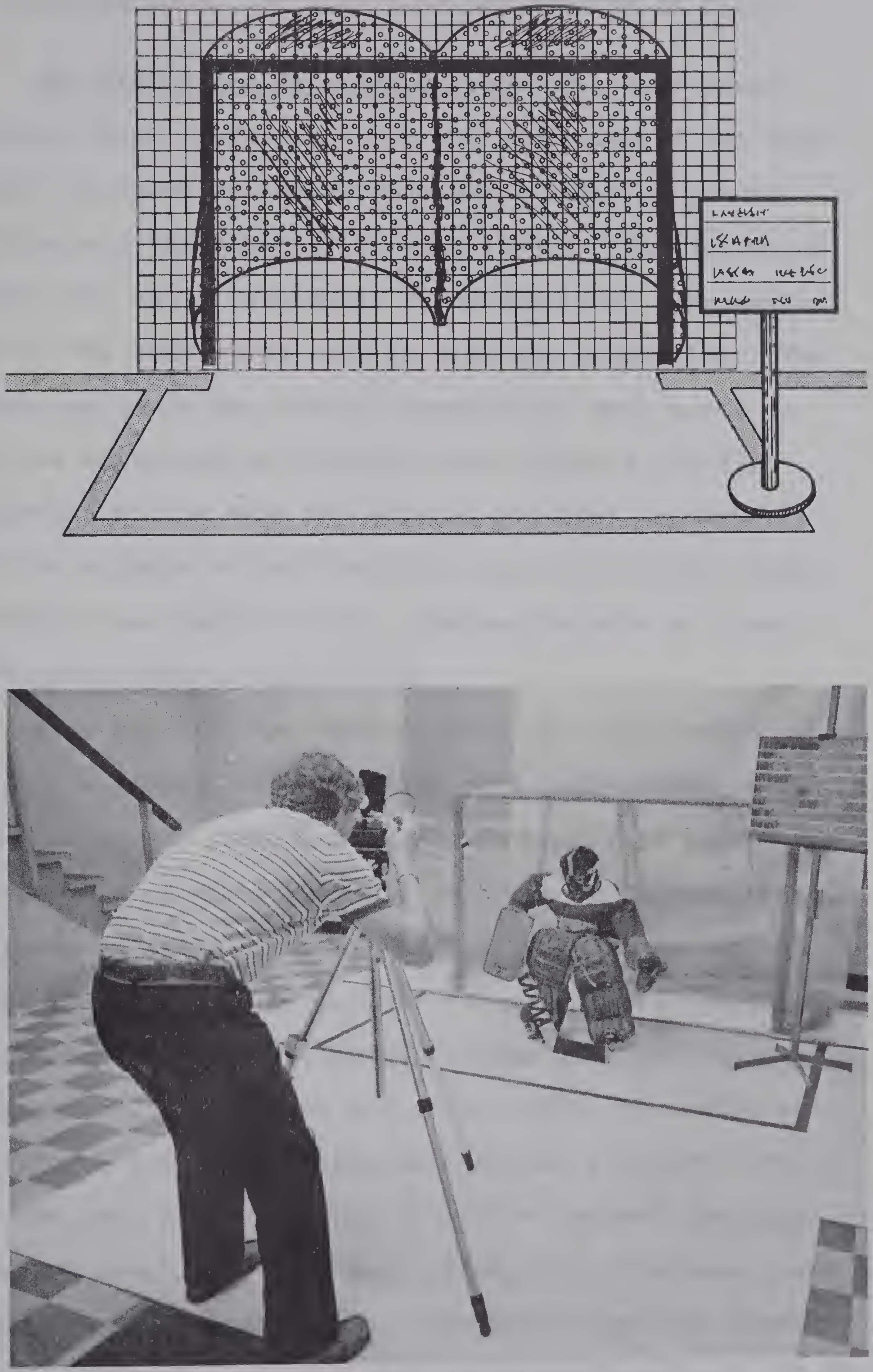


FIGURE 2.0

THE SET

[illegible]

[illegible]

Kodachrome X (64 A.S.A.) color film. The camera was set at 1/60th second speed and with aperture setting of f5.6.

The Self-Image Perception Test. The Self-Image Perception Task (referred to in the remainder of the text as SIPT) is based on the "disassembled manikin" method described and validated by Gunvald (1951). The technique involves the use of schematic two-dimensional representations of the body which vary in size and proportion. The figures may be in the form of drawings of body parts on cards, as described by Gottesman and Caldwell (1966), silhouettes of the body as designed for Hunt and Weber (1960) or cutouts of body parts as used by Gunvald (1951) and Katcher and Levin (1955). Further details of these studies are found in Chapter II.

SIPT was designed specifically for this present study. A standard representation of a goal-tender was taken from Horsky (1963), (see Figure 3.1). This figure was varied by use of a photographic enlarger to form a series of figures in seven different sizes. The heights of the figures were in exact proportion to each other. Three of the figures were proportionately larger than the standard by 7 per cent, 14 per cent and 21 per cent; and three were smaller by 7 per cent, 14 per cent and 21 per cent. The seven per cent difference was chosen to reflect the percentage of total growth of boys of eight to fourteen years of age (Smart and Smart 1967). The percentages of growth at 8-10 years, +6 per cent; 10-12 years, +6 per cent; 12-14

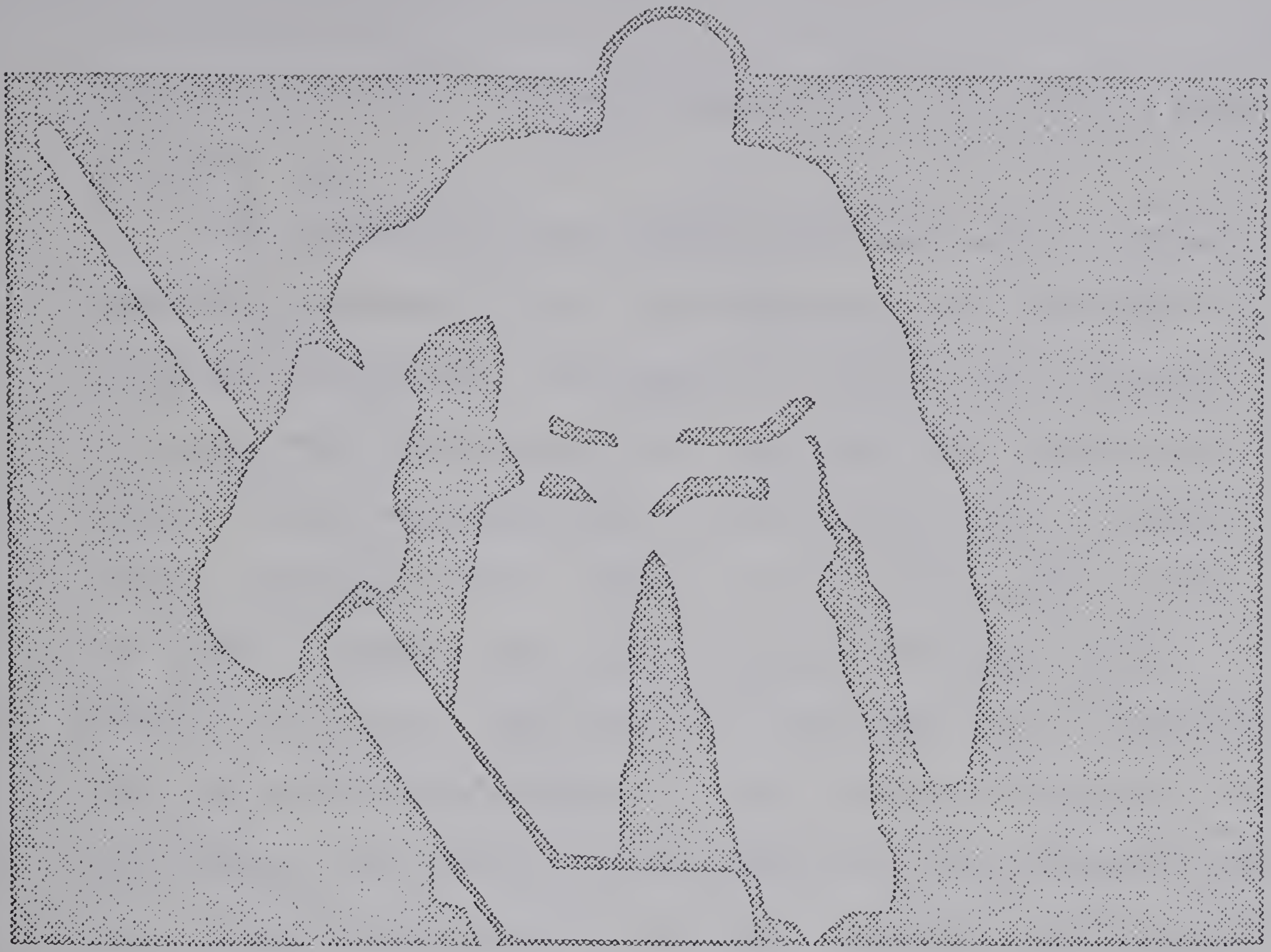


FIGURE 3.1 HORSKY MAN IN STANDARD GOAL

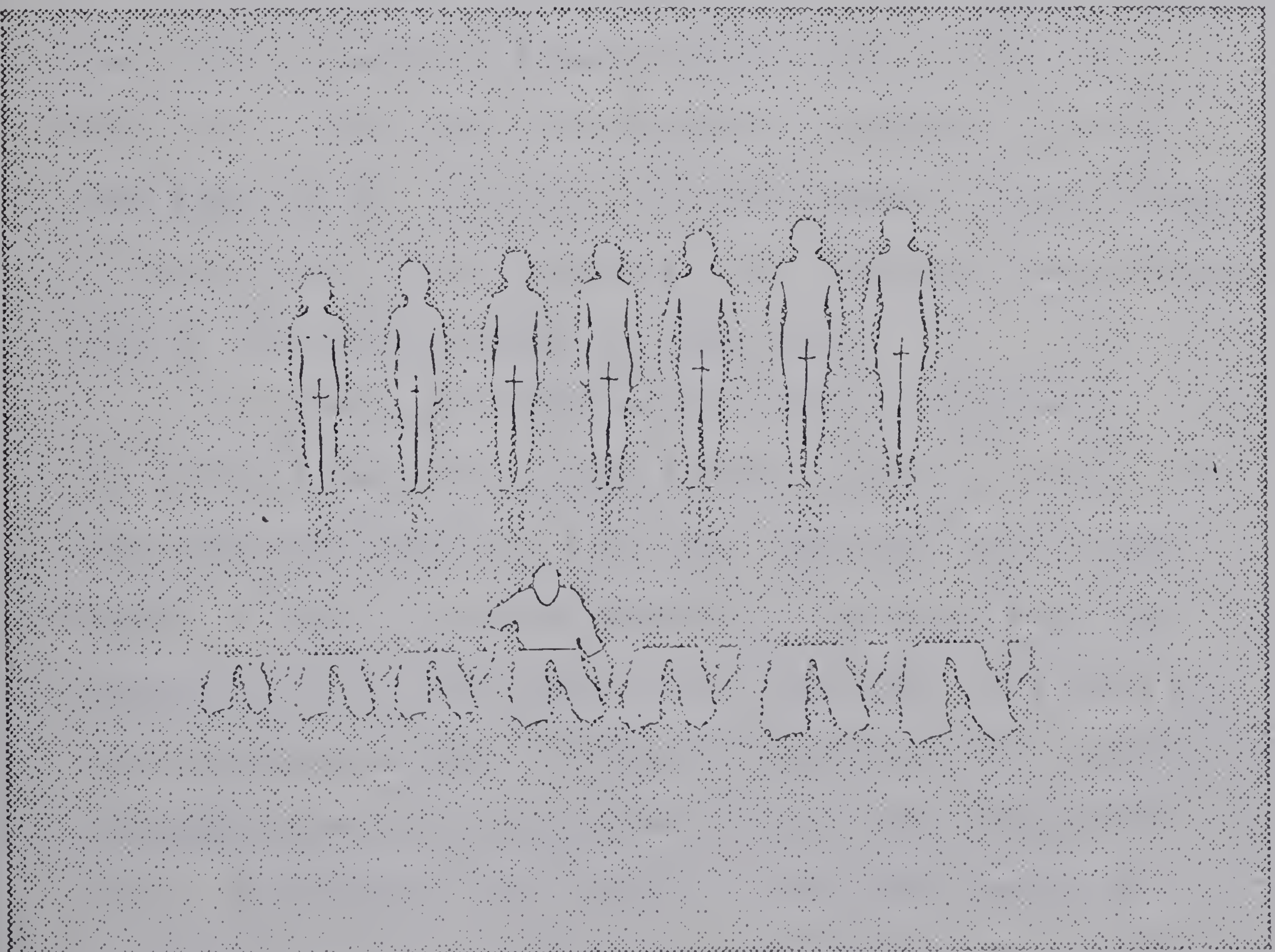


FIGURE 3.2 INCREASES IN HEIGHT, BOYS 8-14 YEARS

years, +7 per cent and 14-16 years, +6.5 per cent are shown in Figure 3.2.

The series of seven figures was made out of white laminated cardboard. Each figure was cut into sections at the waist and gloves. The masks and sticks were separate. The parts were so designed that all the joins fitted perfectly. There were therefore, seven sizes each of masks, sticks, catching gloves, stick gloves and leg pads. Only one body, of median size, around which the other parts could be assembled, was retained. The body was of standard size, or the fourth (middle) in the series of figures. All other parts could therefore be related to the standard body size. They would either be the same standard size or would show a proportional percentage increase or decrease in size. There were altogether thirty-six separate parts (see Figure 4). Each part was numbered according to a code (see Appendix B). The use of coded numbers allowed scores to be recorded but prevented Ss from assuming the relationship of the various parts to each other.

The test instrument was set out as follows. The standard body was placed in the center of a piece of hard board measuring 51 x 55 cm. The board was painted black. A strip of yellow plastic, 5 mm wide, was fixed parallel to the lower edge of the board and 6 cm from it. The body segments were arranged in groups, each composed of different sizes of the same body part, surrounding the board. S assembled the "model" of the goal-tender by

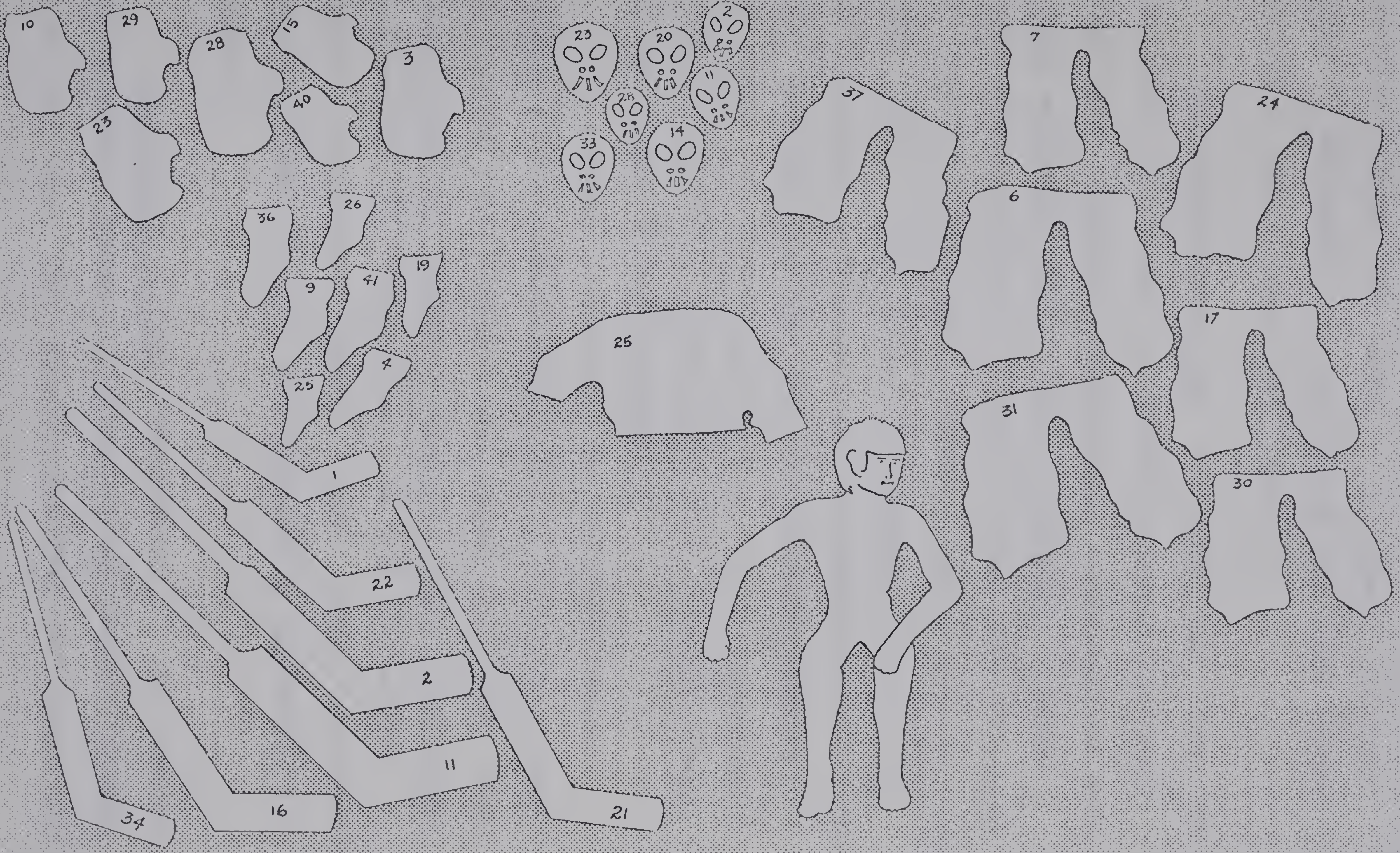


FIGURE 4.0

COMPLETE SIPT INSTRUMENT

Sipt Apparatus

selecting from the body segments. He placed it in the center of the board, with the base of the figure resting on the yellow plastic strip (see Figure).

Goal-construction test. The second part of the SIPT instrument was designed to measure the size of the goal-tender as he perceives himself to be; a) when wearing goal-tending equipment, and b) without equipment. A second black-board was prepared identical to that described above. The figure of an unclothed, slightly crouched boy was placed in the center. This figure was designed as part of the SIPT instrument to represent S as he appeared without equipment. Thus the apparatus used in this task consisted of two boards. One board held the figure of the goal-tender in full equipment as constructed by S. The second board held the figure of the unclothed boy.

In addition, each board was equipped with two L-shaped yellow plastic strips and one long strip. These were used by S to construct goals round the figures. The strips, 5 mm wide, measure L vertical 50 cms, L horizontal 14 cm and the long strip 65 cm. The goal strips were scaled in centimeters, marked in black. Every fifth centimeter was marked in red. The apparatus is illustrated in Figure 5.

The blocking device. (See Figure 6). This instrument provided a measure of estimated body area in relation to the goal area. The structure consisted of a wooden plat-

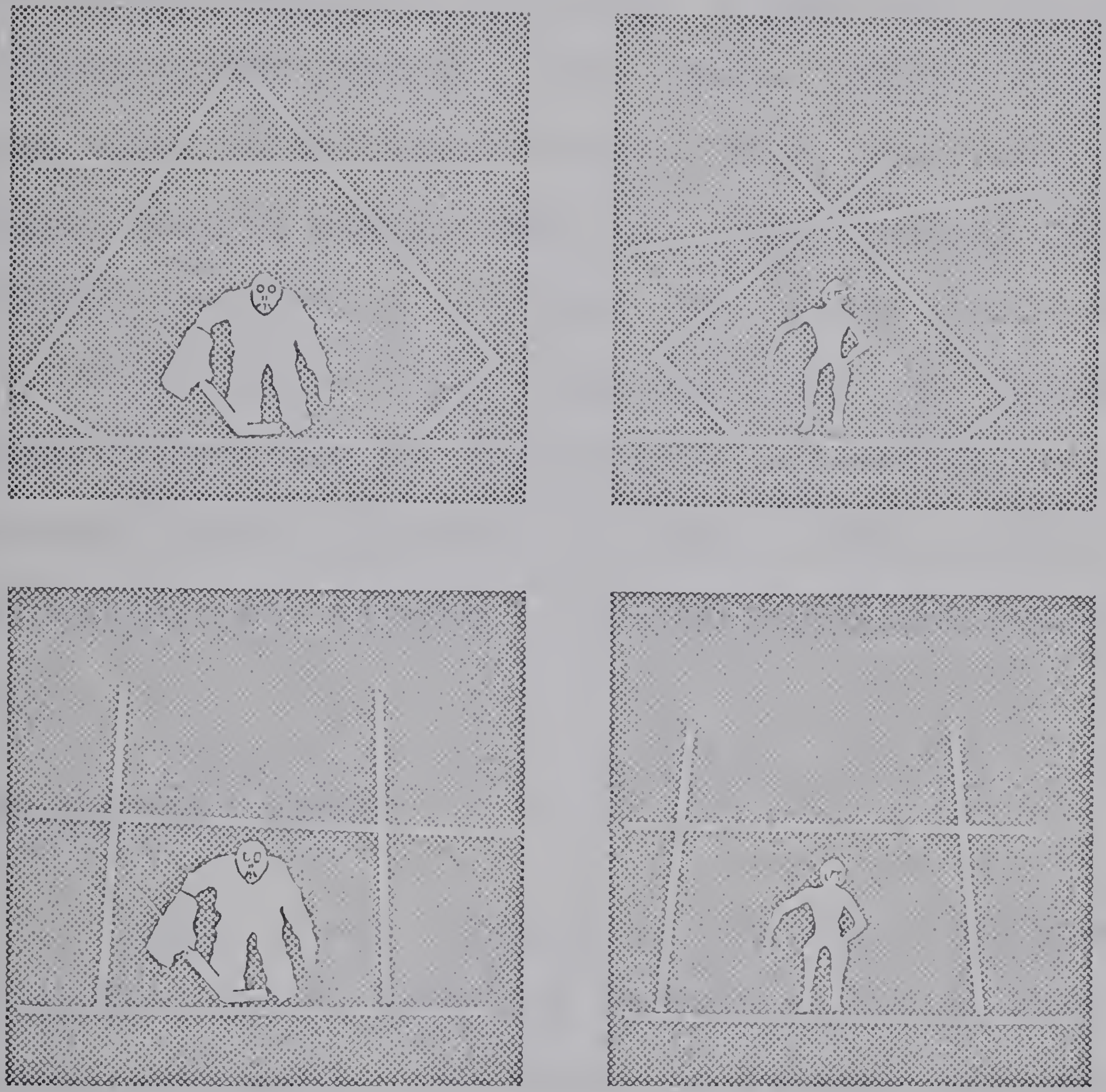


FIGURE 5.0

APPARATUS FOR GOAL CONSTRUCTION TEST

form (a) measuring 46 x 30 cm. Two metal blocks (b1, b2), each consisting of sixty-four parallel, horizontal rods were mounted loosely on a platform. The edges of the blocks abutted in the center. Together the blocks occupied a space 50 x 20 cm. They were held in place by a piece of glass which was fixed at each corner. A goal (c), 15 x 10 cm was painted on the surface of the glass. Thirty-three rods on each side, which backed the goal area, were bound at their distal edge by masking tape (d), which enabled them to be grasped and moved as a block. The blocks could be separated to reveal a space inside the goal area. The exposed space could be adjusted to form an area representing the space occupied by the goal-tender's body. This area could then be measured and related to the goal area painted on the glass.

Experimental Tasks

SIPT. S was required to construct a representation of himself, as he perceives himself to be, in full goal-tending equipment. The "body" of standard size was placed in the center of the board. S selected the mask, gloves, pads and stick, which he estimated to be most like his own. He arranged them around the body on the board to form a "model" of himself.

Goal-construction task. The assembled figure of the goal-tender in full equipment and the unclothed figure of the boy were placed one on each board. The figures repre-

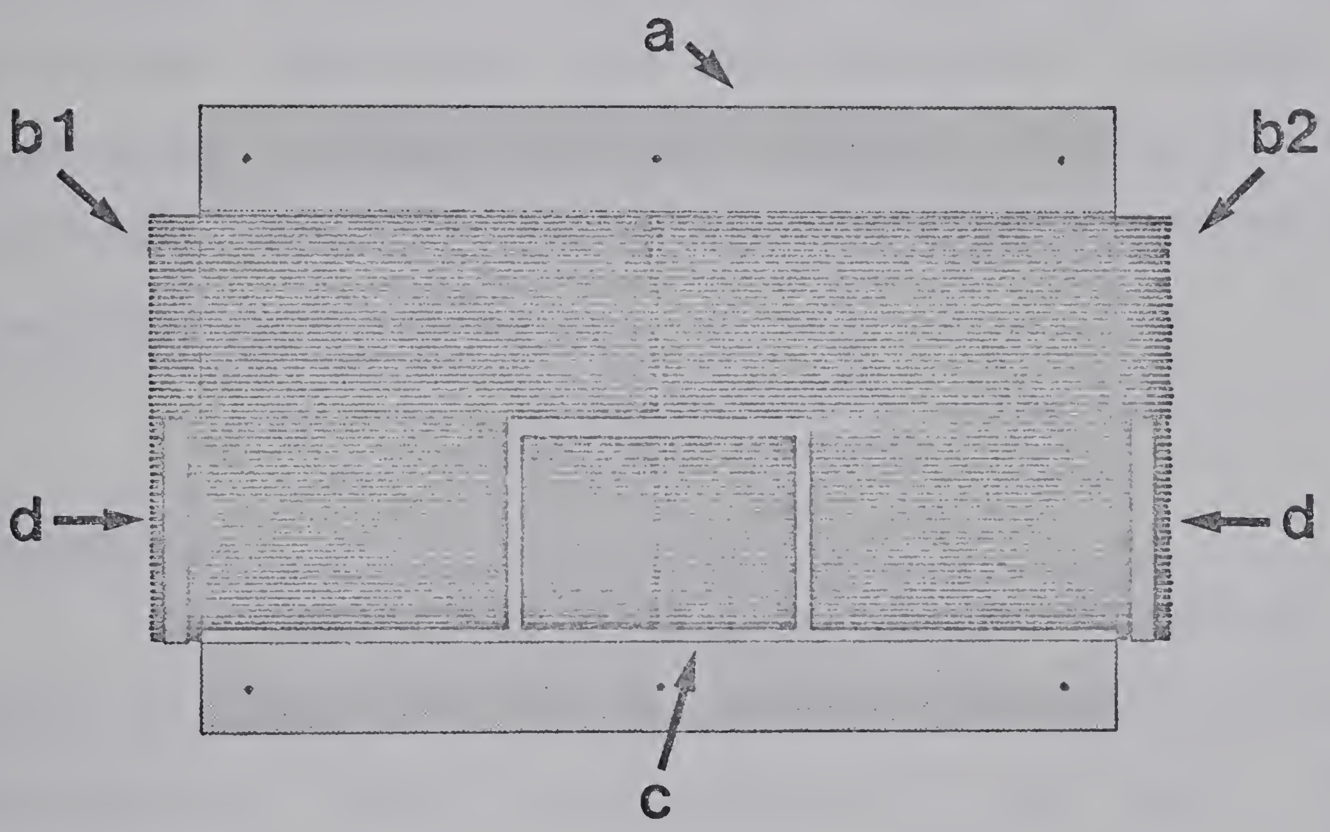


FIGURE 6.0

THE BLOCKING DEVICE

sented S as he stood on the goal line to have his photograph taken; first in full equipment, then without equipment. S was required to construct a goal round each figure to indicate the distance he feels the goal-posts and crossbar to be from his body.

The blocking device. S was asked to separate the two blocks of rods to expose a space in the center of the goal area. S adjusted this space to reveal the amount of goal-space he thinks his body occupies. The area of the goal-space still covered by the rods represented the area unblocked by the body.

Subjects

One hundred and sixty goal-tenders, who played regularly in league games of the Edmonton Metropolitan Hockey Association, 1973-74, were subjects for the study. They were from the following groups:-

Forty-nine Mites, aged ten years and under,
Fifty-three Pee Wees, aged twelve years and under,
Fifty-eight Bantams, aged fourteen years and under.

The ages given above are as of January first of the year registration to play takes place.

Method

Each S was tested individually. The testing session was in three parts; an interview, a photographic session and the completion of tasks.

The interview. When S arrived he was interviewed by E in order to record personal details. The name, date of birth, team and community were entered on a numbered data-sheet (see Appendix B). S was weighed and the weight recorded in kilograms. His height was recorded in centimeters. Details of his performance as a goal-tender were taken. The number of wins, losses and goals scored against were recorded.

The photographic session. S entered the laboratory after his interview and was helped to don his goal-tending equipment (see photograph). Having selected the appropriate stick, he moved into the goal crease provided. He took up his position as close to the grid as possible. His distance from the grid was approximately eighteen inches. On a command from E he moved into his habitual goaler's stance and the photograph was taken. A second picture was taken in the same way. S then changed into a T-shirt and a pair of short-legged gym shorts. The same procedure was repeated and two more photographs were taken.

The tasks. S dressed in his normal clothing, was shown into a separate office where SIPT and the goal-construction task were set out. SIPT was explained to S. He was allowed to ask questions and to discuss the task with E if he wished. He was then left alone to complete the task. There was no time limit. S informed E when he had finished the task.

The goal-construction task was then explained to S. The same conditions obtained for performing this task. When it was completed S moved to another part of the laboratory where the blocking device was placed. Instructions were given to S by E. While S worked, E returned to the office where he recorded the measurements for the first two tasks.

After all tasks were completed and the results recorded on the data-sheet, S looked at the display material and discussed the purpose of the tests with E. The whole session took approximately thirty minutes.

Methods of Measurement

Each slide was projected through a translucent screen. A piece of Mercury blue grid tracing paper was placed over the projection so that the one-tenth inch squares on the paper exactly matched the one inch squares of the grid on the slide. The outline of the body of S was traced on to the graph paper. There were two outlines for each S; one taken from a photograph without equipment and one taken from a photograph in full equipment. The area of the body space was then computed by counting the squares inside the boundary line. As each square (1/10") on the graph paper represented one 1" grid square, the life size area of the figure was recorded in square inches.

SIPT was scored by recording the numbers of each piece selected by S. The numbers, when decoded, were entered on the data-sheet (Appendix A). Each piece was measured in the same way as the figures on the photographic

slides. It was traced on to similar graph paper, and the squares inside the line of the tracing were counted. The measures thus obtained were increased to life-size areas by multiplying by the SIPT ratio. The SIPT ratio is the number which reduces the area of the SIPT figure to the standard Horsky figure in 1/10". The method for computing the SIPT ratios for area and for length, are given in Appendix C.

The height and width of the goals constructed by S were measured in centimeters marked on the apparatus. These figures, recorded on the data sheet were increased to life size by the SIPT ratio for length. The blocking device yielded a measure for area, the height of which was constant at ten centimeters. The width was recorded in centimeters and converted to life-size measurement.

Eventually, all measures were increased to life-size, and converted into centimeters.

Statistical Analysis

Data was compiled in a coded form on the data sheet (Appendix A). A Fortran IV WATFIV conversion program was used to insert the appropriate values from the present scores for SIPT body parts which correspond to the numerical code on the data sheet. The code is shown in Appendix B and the corresponding scores in Table 6 in Appendix D.

In addition the program converted the remaining scores relating to subjects' photographic size and estimates of goal size into the correct units, centimeters squared. The corrected scores were then converted by SIPT ratio into real life size (Appendix C). The program also calculated the total body area (SIPT) and the estimated area of the goal, with and without equipment.

The converted data was then subjected to a sorting process by a Fortran IV WATFIV program. Scores were redistributed into ascending order and every fifth percentile point was designated.

The analysis was carried out on an IBM 360/37 computer at the University of Alberta Computing Science department.

CHAPTER IV

ANALYSIS

The effect of wearing heavy equipment on perception of body size is the central problem of the study. Ice hockey goalers were chosen as subjects as they take part in strenuous activity while wearing cumbersome protective clothing. They are confined to a small strictly prescribed area of operation. They play three or four games regularly each week and are familiar both with the space in which they work and the clothing they wear. The problem was to isolate and measure the goaler's perception of these two variables, with which they are so familiar but to which they are not accustomed to pay attention.

In dealing with the problem several objectives were defined. These were:-

a) to find the effect of wearing equipment on the perception of the size of separate body parts,

b) to relate perceived body size to actual body size under two conditions; i) the wearing of goal-tending equipment; and ii) without equipment,

c) to relate perceived goal size to actual goal size under the same two conditions,

d) to measure the area of the goal the goaler thinks he blocks with his body,

e) to determine the effect of different age levels on

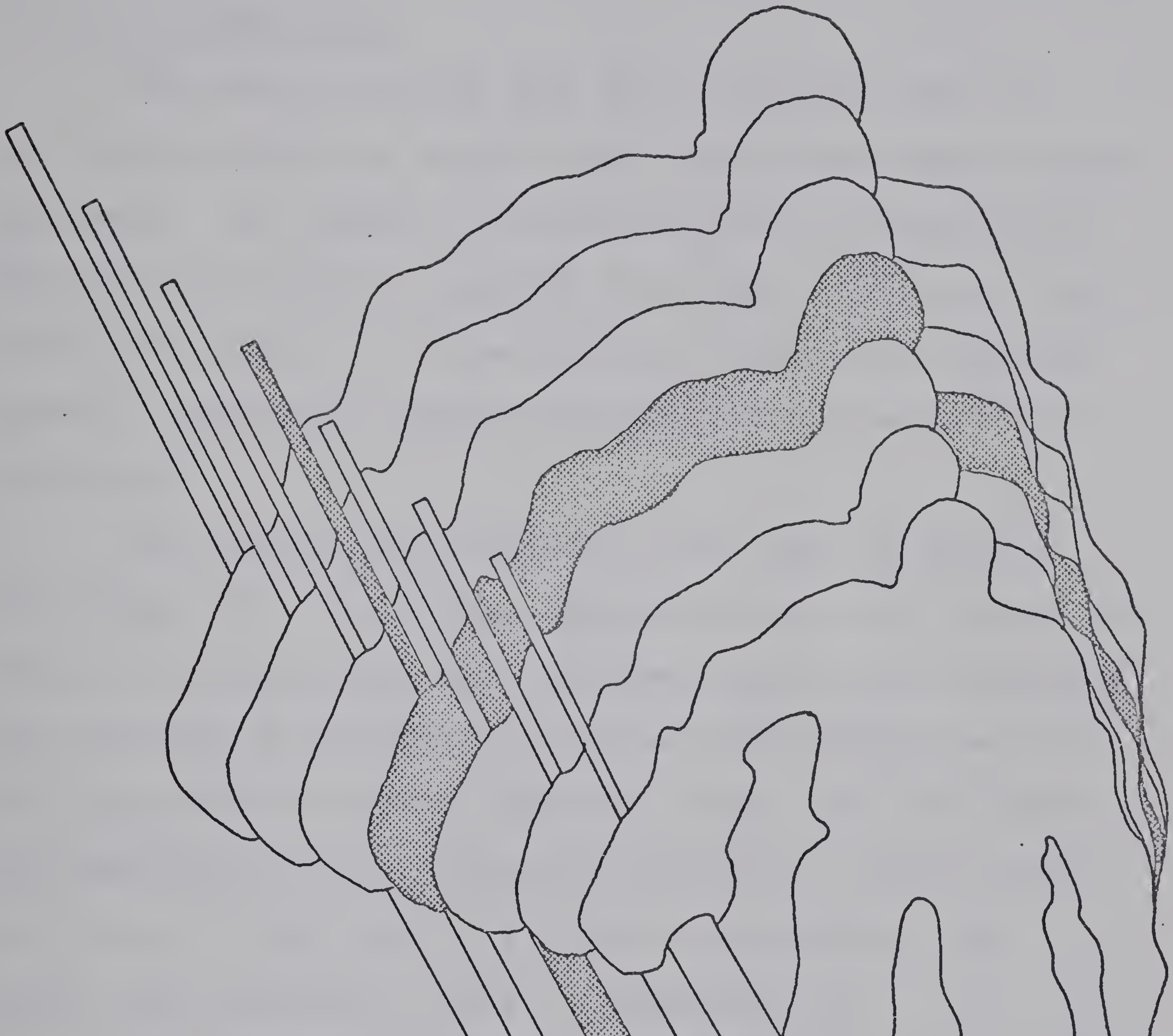


FIGURE 7.0

DIAGRAM ILLUSTRATING SIPT SCORING
SIPT(4), MID-SIZE, IS NORMAL

perception of body size.

Each of these objectives and their related findings will be discussed.

a) Size of body parts.

The aim of the SIPT test was to find out how the goal tender perceives separate body parts when wearing heavy equipment. For example, does the wearing of the mask make his head seem larger or smaller than usual? How large does he feel his hands to be when wearing blocking and catching gloves? How does he see the relationship of one body part to another?

The standard body (mid-size) was taken as normal. (See Figure 7). If subjects chose parts that were larger or smaller than the normal size they were said to be distorting in a positive or negative direction. Parts scored as 1, 2, or 3 were proportionately less than normal (4), and therefore were distorted in a negative direction. Parts scored as 5, 6, or 7 were seen as a positive distortion. All scores are recorded in Table 6. (Appendix D).

The available range was seven different sizes of five different body parts: glove arm, stick arm, stick, legs and head. Graph I illustrates the range of scores for the three groups of subjects represented in this study; Mites aged 10 years, Pee Wees aged 12 years and Bantams aged 14 years. The rectangular area marks the limits of the middle 50% of scores in the distribution, the interquartile range. The total range is indicated by the thin line ending in a T

TABLE 1

SCORES OF SIPT BODY PARTS

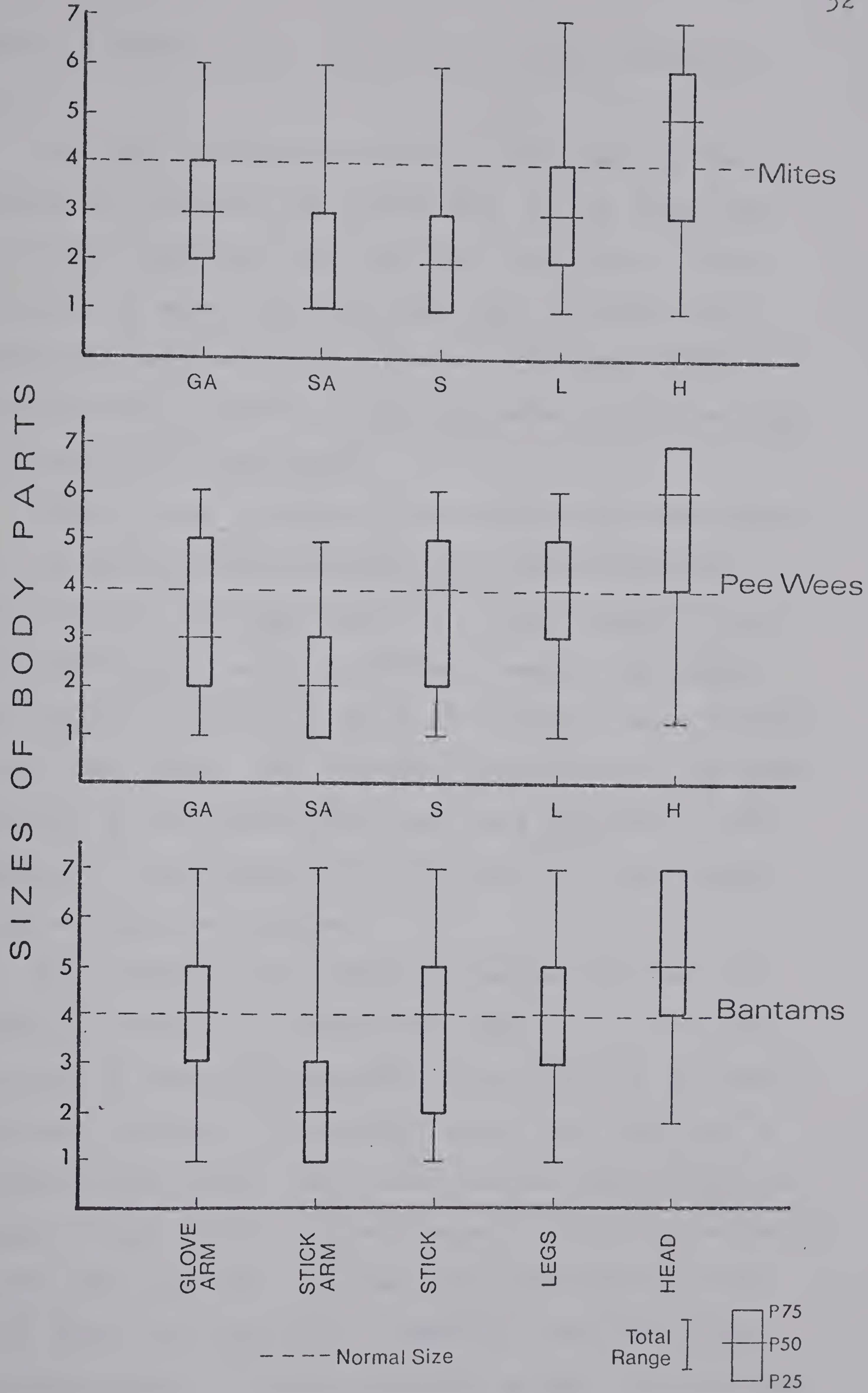
P	MITES					PEEWEES					BANTAMS				
	GA	SA	S	L	H	GA	SA	S	L	H	GA	SA	S	L	H
1	1	1	1	1	2	1	1	1	1	2	1	1	1	1	2
25	2	1	1	2	3	2	1	2	3	4	3	1	2	3	4
50	3	1	2	3	5	3	2	4	4	6	4	2	4	4	5
75	4	3	5	4	6	5	3	5	5	7	5	3	5	5	7
99	6	6	6	7	7	6	6	6	6	7	7	7	7	7	7

TABLE 2

PERCENTAGE FREQUENCY SIPT BODY PARTS

SIZE	MITES					PEEWEES					BANTAMS				
	GA	SA	S	L	H	GA	SA	S	L	H	GA	SA	S	L	H
1	22	66	40	16	0	13	47	15	8	0	11	33	9	4	0
2	16	8	14	26	14	13	20	17	13	7	11	22	22	11	7
3	24	16	22	24	14	25	13	17	28	11	20	24	11	22	4
4	22	8	8	18	14	12	10	22	23	18	20	11	20	36	18
5	10	0	6	12	28	25	7	17	21	23	27	6	16	26	25
6	6	2	10	2	16	8	3	12	5	27	7	4	18	13	16
7	0	0	0	2	14	3	0	2	0	23	4	2	4	2	29

GA = Glove Arm
SA = Stick Arm
S = Stick
L = Legs
H = Head



GRAPH 1.0

RANGE OF SCORES FOR SIPT BODY PARTS

junction. Scores for P1, 25, 50, 75, 99 are recorded in Table 1.

The most noticeable feature of the graph is the weighting of scores at the lowest size of the stick arm. As the median falls at this level for the Mites, 50% of this group, or more, selected this size. Pee Wees and Bantams also selected small sizes of stick arm, their medians falling at size 2, which indicates an extreme negative distortion of this part.

There is not a similar bias towards the other glove hand. In this case the interquartile range covers the normal size (4), although there is a slight negative deviation, particularly among the Mites. Barton and Wapner (1962) refer to the way in which instruments become blurred into the body image. One possible explanation of the underestimation of the stick glove could be a blurring of the perception of stick and glove into one active instrument, with ill-defined boundaries.

The catching glove, which is smaller in size, is generally estimated as considerably larger. As it is the sole piece of defensive equipment on one side of the body, it becomes the focus of defensive action over one half of the exposed goal area. Also it is the one single piece of equipment which allows the goal keeper to take possession of the puck with his body. In play, the glove hand is constantly active and very fast. Possibly, the great range, speed and activity of this part tends to make it loom large

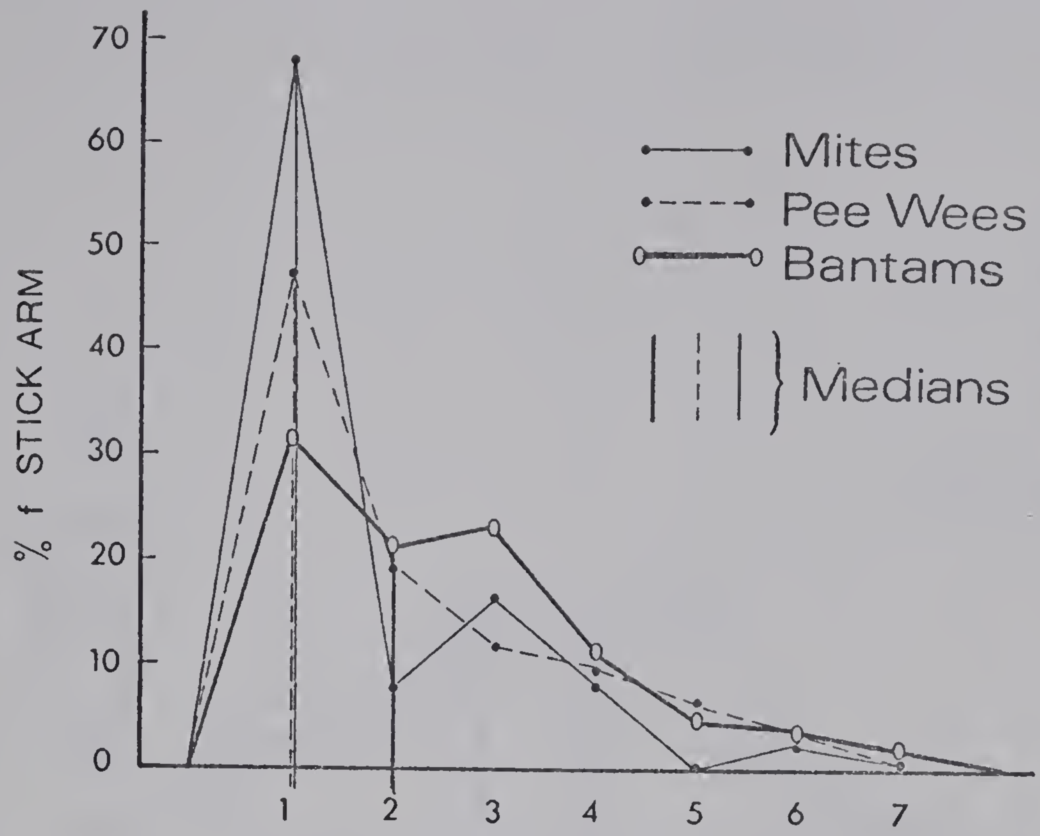
in perception.

The legs and stick scores show a general underestimation of size as found by Shontz (1967) and Nash (1969). The youngest group again show the most extreme distortion. The scores indicate that the Mites choose small sticks. During the testing several subjects complained that the available sticks were too large. On further discussion it became apparent that they usually used large sticks, but as they could not manage the long handle, the end was cut off by the coach.

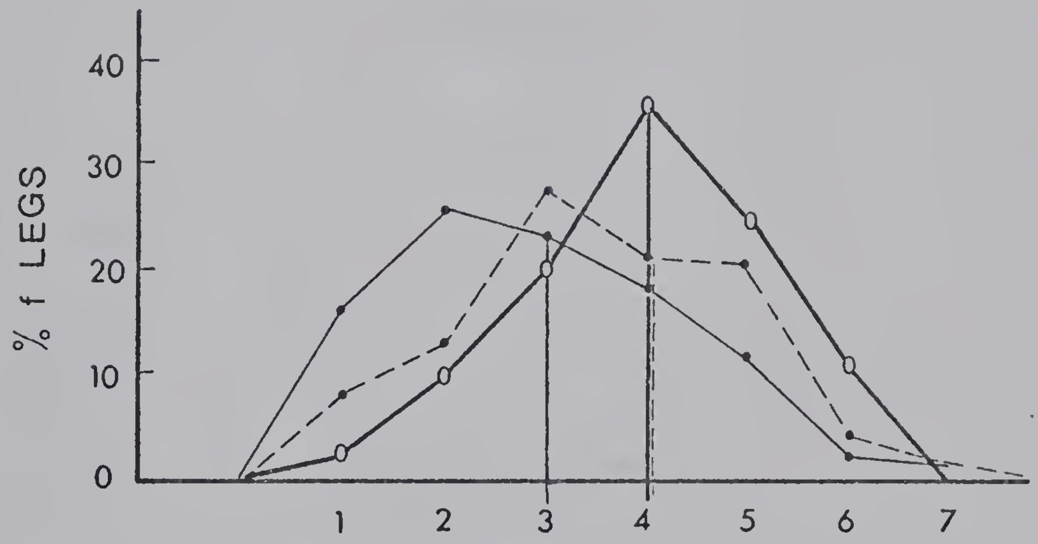
The only part of the body to be overestimated was the head. Only 11% of the subjects selected heads that were of normal (4) size or smaller. This confirms the findings of Werner, Wapner and Comalli (1957) and Nash (1969).

The frequency polygons, Graphs 2.1-2.5, show a generally uniform distribution, with very little difference between the age groups. The two skewed distributions already mentioned, head and stick arm, are emphasized by a sharp rise in the frequency scores at the higher sizes in Graph 2.3 and the lower end of Graph 2.1.

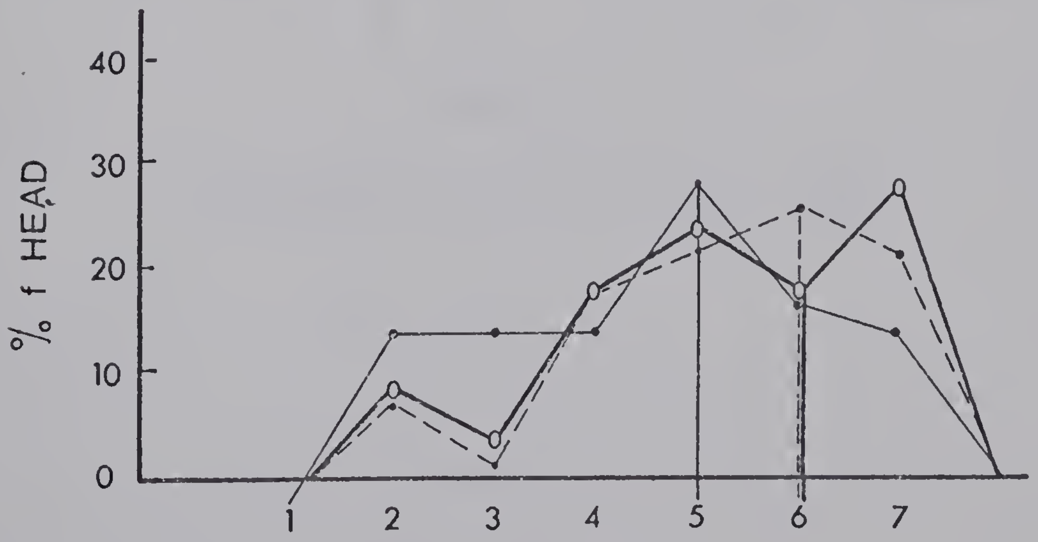
It is noticeable that curves for Bantams generally lie between the other two age groups. This confirms the theory of Witkin (1962), who found, in his longitudinal studies, a more closely articulated body concept as children grow older. Graph 2.4 is the only one in which the Bantams deviate from the other groups, and this is in the direction of the normal (4). The tendency of the older



GRAPH 2.1

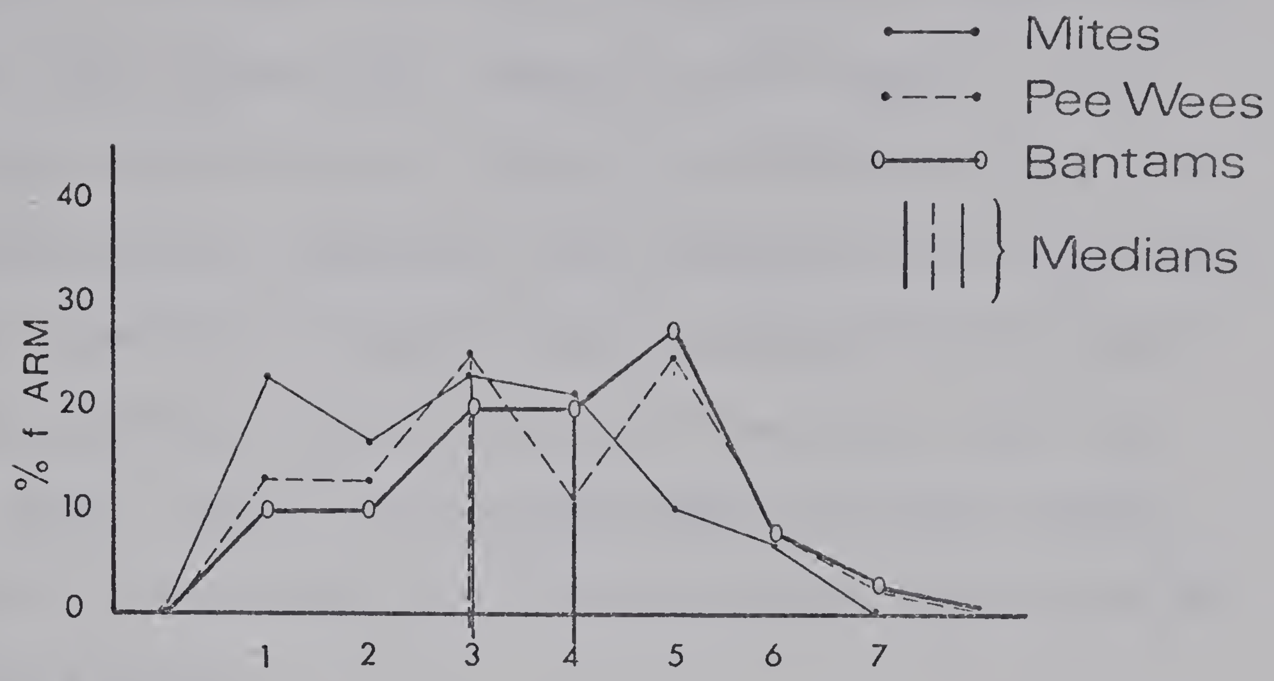


GRAPH 2.2

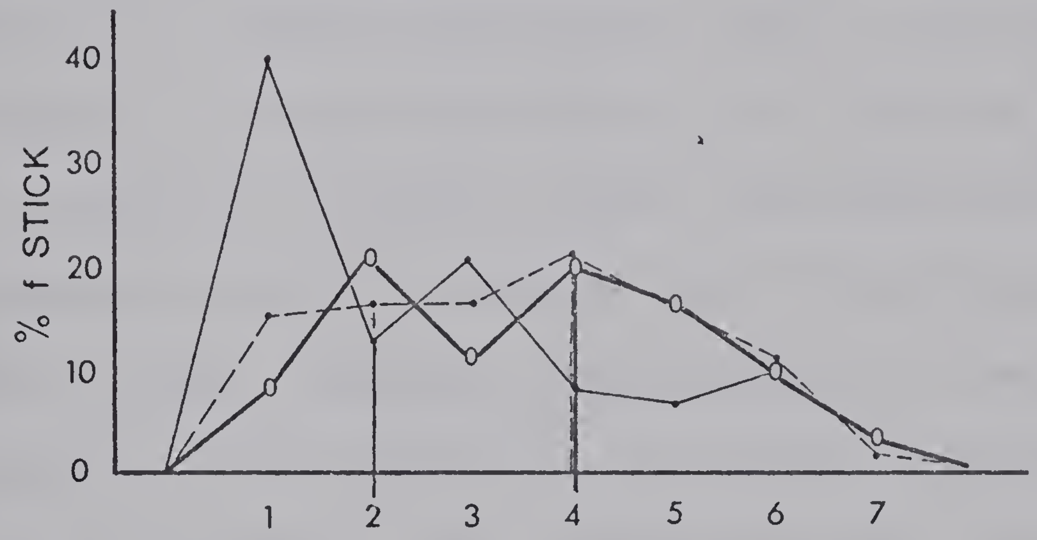


GRAPH 2.3

FREQUENCY OF SIPT BODY PARTS



GRAPH 2.4



GRAPH 2.5

FREQUENCY OF SIPT BODY PARTS

group to select the normal size of body parts is demonstrated in all graphs.

Graph 1.0 shows the Mites' selection of parts never rises above the normal (4), except for the head. It is possible that their choices reflect their actual body size. They select from the smallest sizes because they feel small. They often asked for a smaller body, saying that the constant body provided, (approximately 2" across), was too large for them. Even on the large sized mounting board, they wished to represent their feeling about their size by a very tiny figure.

In sum the scores reflect the change in actual body size of the different age groups. As the boys grow they see themselves as larger and express this in the formation of their models. Of the three groups, the Bantams are closer to normal (4) in their scores, which may show a more accurate awareness of the relative size of body parts with an increase in age. General overestimation of the head, and underestimation of the stick arm are the two outstanding features of the scoring. All groups show this tendency.

Mites, on the whole, chose smaller sized sticks, while other groups more closely paralleled the size of the stick to the size of the legs.

Apart from these diverging factors the scores reflect patterns of structural growth and psychological maturity, (Witkin et al 1954).

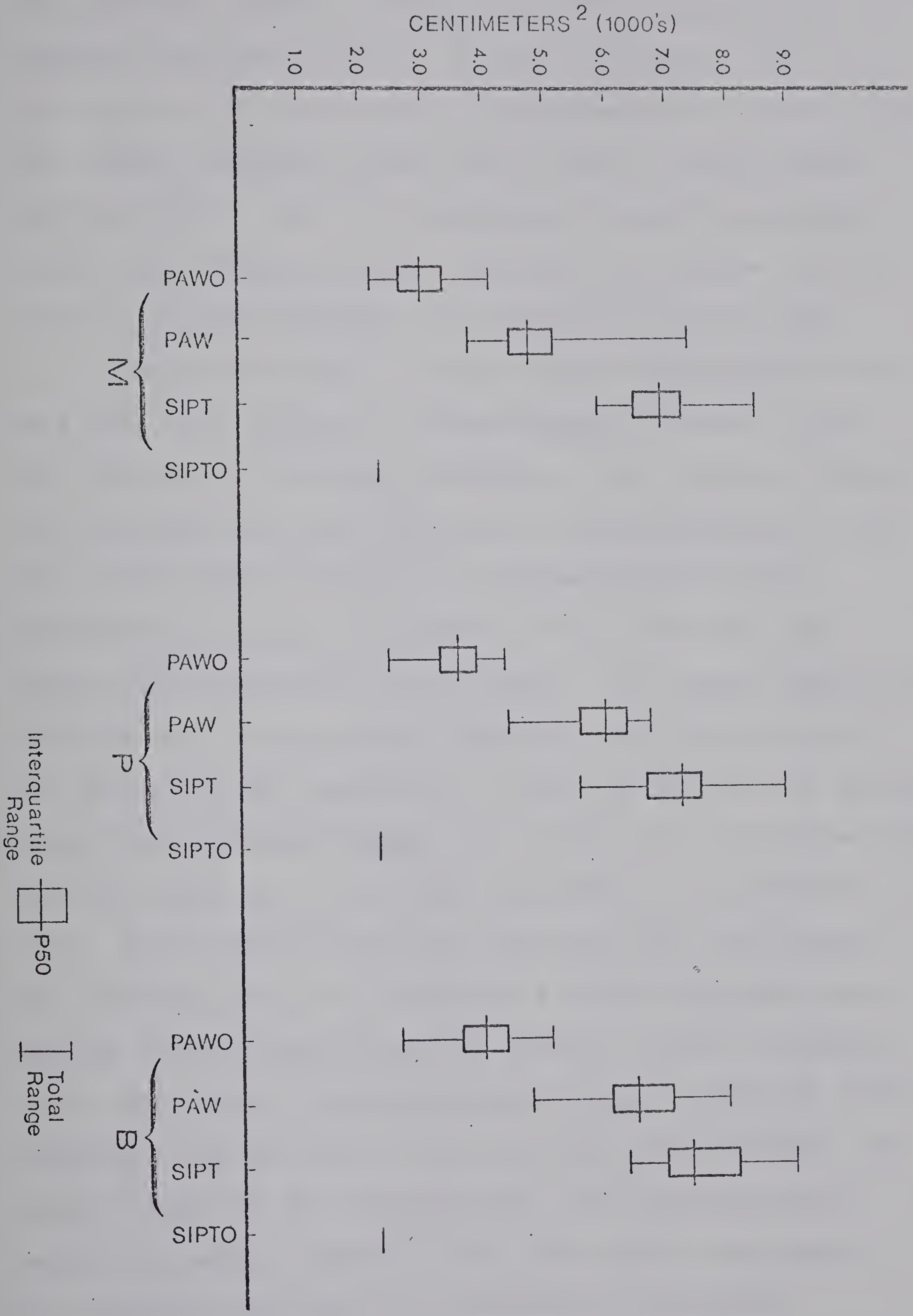
b) Actual and perceived body size, with and without equipment.

The actual body size was measured by computing the area of the photographs of the goaler (see Page 45), in his equipment (PAW) and without equipment (PAWO). The results are recorded in Table 8 (Appendix D). Scores at PSO are shown in Table 4. The perceived body size was measured by the SIPT test, which includes the body assembled by S (SIPT) and the unclothed figure (SIPTO).

The actual goal size is standard. The area (RGA) is 22296 sq. cms. The areas of SIPT goals for SIPT and SIPTO were computed for each S. All results were transformed to life size (see Page 45) and are recorded in Table 8 (Appendix D).

The problem is two-fold. It is to find a measure of the perception of body size and to find the effect on body perception of heavy equipment. The perception of body size was measured in relation to a perceived goal size and was expressed as a percentage area of this goal size. It was then related to a standard, this being the area of a photograph of the goaler himself in a standard goal net. This measure was also expressed as a percentage of the standard goal size.

The range of actual measurements of body area is shown in Graph 3. It is divided into three blocks representing the three groups involved in this study; Mites, Pee Wees and Bantams. The three blocks are similar in pattern. They show an increase in size from body area with-



GRAPH 3.0

RANGE OF SCORES FOR BODY AREAS,
ACTUAL AND PERCEIVED SIZE

out equipment (PAWO), to body area with equipment (PAW) to perceived body area (SIPT). A score of 2280 sq. cms. (see line, Graph 3.0) represents the unclothed SIPT figure (SIPTO). The gradual increase in size due to age is clearly shown (PAWO and PAW). This is reflected by the SIPT groupings, which also increase in size, although the increase is very slight. It does not match the increase in actual size.

Graph 4.0 shows the body areas as percentages of the goal area they occupied. The percentage of actual sizes were obtained by computing PAWO/RGA x 100, PAW/RGA x 100 and the perceived sizes by SIPTO/GAWO x 100 and SIPT/GAW x 100. (The scores GAWO and GAW were obtained from the goal-construction test by the product of the perceived goal height and the perceived goal width). The scores inside the interquartile range cluster tightly round the median for all groups for all conditions. Those for SIPT show a greater range than all other groups. The scores rise proportionately for each group and become more dispersed as they increase in size. Both in perceived size (SIPT and SIPTO) and actual size (PAW and PAWO) the differences between the goal area covered with equipment and that covered without equipment, become more marked with an increase in age. SIPT and SIPTO exaggerate PAW and PAWO. The perceived scores inflate the larger scores of the equipped body, and correspondingly reduce the smaller scores of the body without equipment. The perceived enlarges the direction of the actual.

Graph 5.1 shows by how much this directionality is

TABLE 3

BODY AREA AS PERCENTAGE OF GOAL AREA

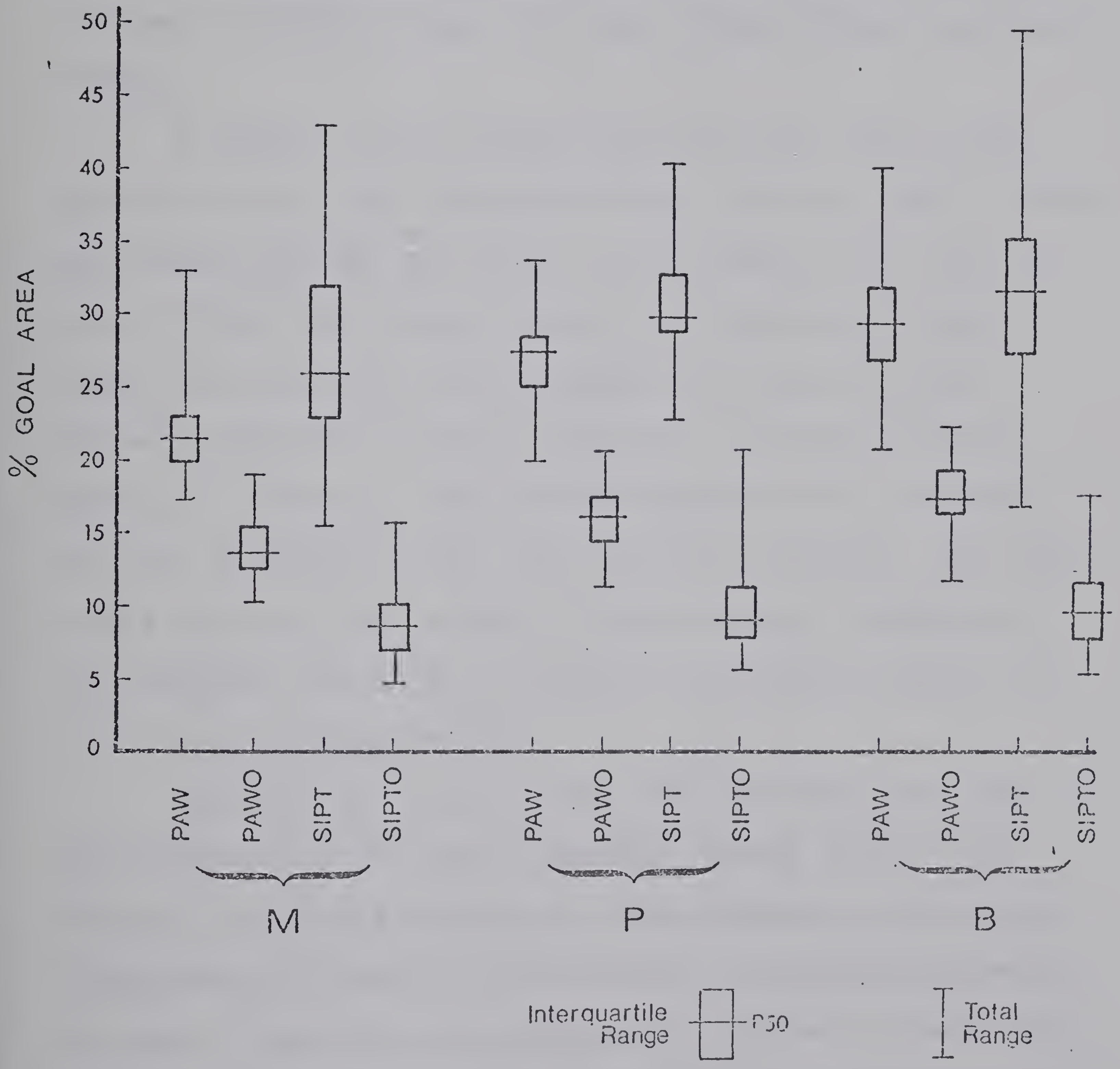
P	MITES				PEEWEES				BANTAMS			
	PAWO	PAW	SIPTO	SIPT	PAWO	PAW	SIPTO	SIPT	PAWO	PAW	SIPTO	SIPT
1	10	17	5.2	16	12	20	5.9	23	12	21	5.63	18
25	12	20	7.42	23	15	25	8.0	29	17	27	8.39	28
50	13	22	8.8	26	16	27	9.3	30	18	29	9.65	32
75	15	23	10.1	32	18	29	11.4	33	20	32	11.4	36
99	19	33	15.1	43	21	34	22.4	40	23	41	18.1	50

PAWO = Actual (photographic) Size Without Equipment
PAW = Actual (photographic) Size With Equipment
SIPTO = Perceived Size Without Equipment
SIPT = Perceived Size With Equipment

TABLE 4

PERCENTAGE EQUIPMENT OF TOTAL BODY AREA AT 50th PERCENTILE

	MITES	PEEWEES	BANTAMS
PAW - PAWO	8.1%	11.2%	11.1%
SIPT - SIPTO	17.2	20.7	22.35
PERCEIVED - ACTUAL Area of Equipment	9.1	9.5	11.23



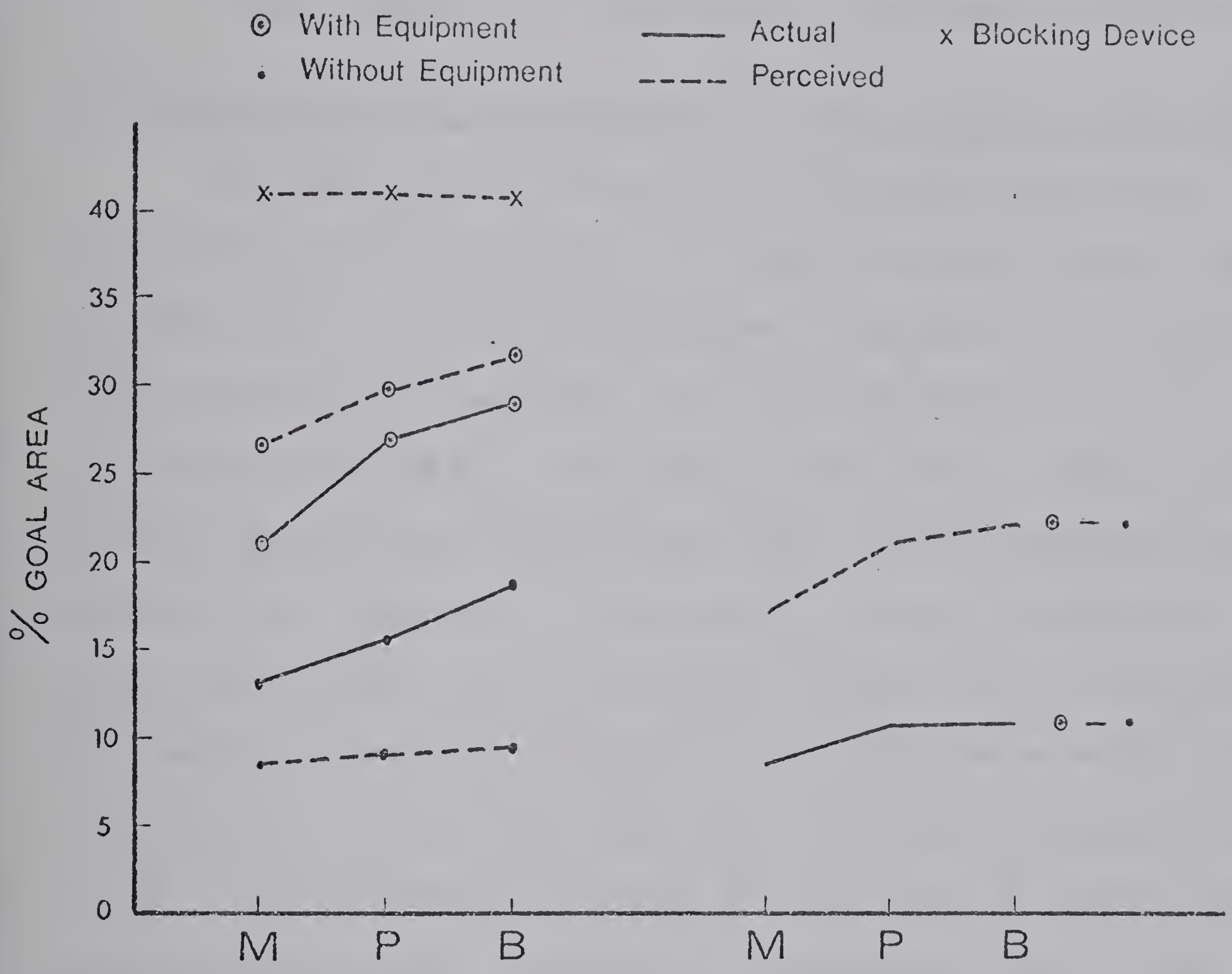
GRAPH 4.0

BODY AREA AS A PERCENTAGE OF GOAL AREA

inflated. The medians of actual and perceived size, with and without equipment are plotted. Curves for perceived size lie outside those for actual size, illustrating the directionality of the perceptual bias. The curves for actual and perceived size with equipment are closer than those without equipment. While the curves for scores with equipment converge as age increases, those without equipment diverge.

A measure of the actual and perceived size of the equipment itself was obtained by PAW - PAWO and SIPT - SIPTO. The results for all age groups are in Graph 5.2. The two curves follow each other exactly at a distance of approximately ten per cent. This suggests that goalers overestimate the size of their protective equipment by this amount, on average. When similar calculations are made at the 25th percentile (P25) and the 75th percentile (P75) the curves parallel that of P50. The percentage overestimate for equipment at P25 is 8.3 per cent on average and at P75 is 13.4 per cent on average.

Finally, the results show that perception of body size exaggerates the true situation (actual size). The subject, in all his equipment, overestimated his own size. Immediately he removes his equipment, he underestimates his own size. There is a two-dimensional contrast between the conditions, a decreasing overestimation of 6-3% with equipment and an increasing underestimation of 4.5-8% through the age groups. The size of the equipment itself is inflated by



GRAPH 5.1

GRAPH 5.2

Graph 5.1: Medians of ranges for actual and perceived size, with and without equipment.

Graph 5.2: Actual and perceived size of equipment. Medians.

perception approximately ten per cent. These calculations, being made from median scores, imply that fifty per cent of the subjects or more may be misjudging the true situation relating to their own size in the goal space.

These results are discussed at the end of section d).

c) Relationship of perceived goal size to actual goal size.

In this problem attention is diverted from body perception to the perception of the surrounding space, and the size of the goal in particular. The goal perception task requires S to estimate the size and distance of the goal height and width. He must do this twice. The first time he constructs a goal round SIPT, which represents himself in full equipment. The second time he constructs a goal round SIPTO, which represents himself without equipment. The method of scoring determines the difference between the actual goal size and the goal size the goaler perceives it to be. The difference between the two sets of scores that result from the two conditions is said to be due to the effect of wearing equipment.

The actual goal size is height (RGH) 121.92 cms x width (RGW) 182.88 cms. The perceived goal size is taken from the results of the goal construction test and adjusted to life size. The relationship is shown by a set of measures of over and under estimation obtained by deducting perceived size from actual size (RGH - GH and RGW - GW). Thus four sets of scores were obtained; for estimation of goal height with equipment (RGH - GHW) and without equipment (RGH - GHWO),

and for estimation of width, with and without equipment (RGW - GWW and RGW - GWWO). These scores for P1, P25, P75 and P99 are recorded in Table 8 (Appendix D).

The negative scores represent an over estimation of size, that is GH and GW > RGH and RGW, and positive scores represent an underestimation of size, GH and GW < RGH and RHW. The scores were expressed as a percentage deviation from the real size. They were calculated by (RGH - GHW)/RGH x 100. Similar calculations were made for height and width under both conditions of clothing. All scores are recorded in Table 9 (Appendix D). Median scores are shown in Table 4. They are shown in Graph 6 as positive or negative deviations from the real size (real size is represented by the x axis).

The pattern of scores is similar for all groups under all conditions. The interquartile range remains within 20% of the real size. All scores for perceived size with equipment straddle the x axis and their medians remain within 4% of it. Thus the estimates for goal height and width vary little from the actual size when the goaler is wearing equipment. The interquartile range for scores without equipment are more erratic and move further from the real size. The total range for GWO and GWWO also increases as the age range increases.

Graph 7.1 illustrates the difference between the medians for scores with and without equipment.

The grouping of medians to within 4% of the actual size shows the accuracy of estimates made by goalers of the

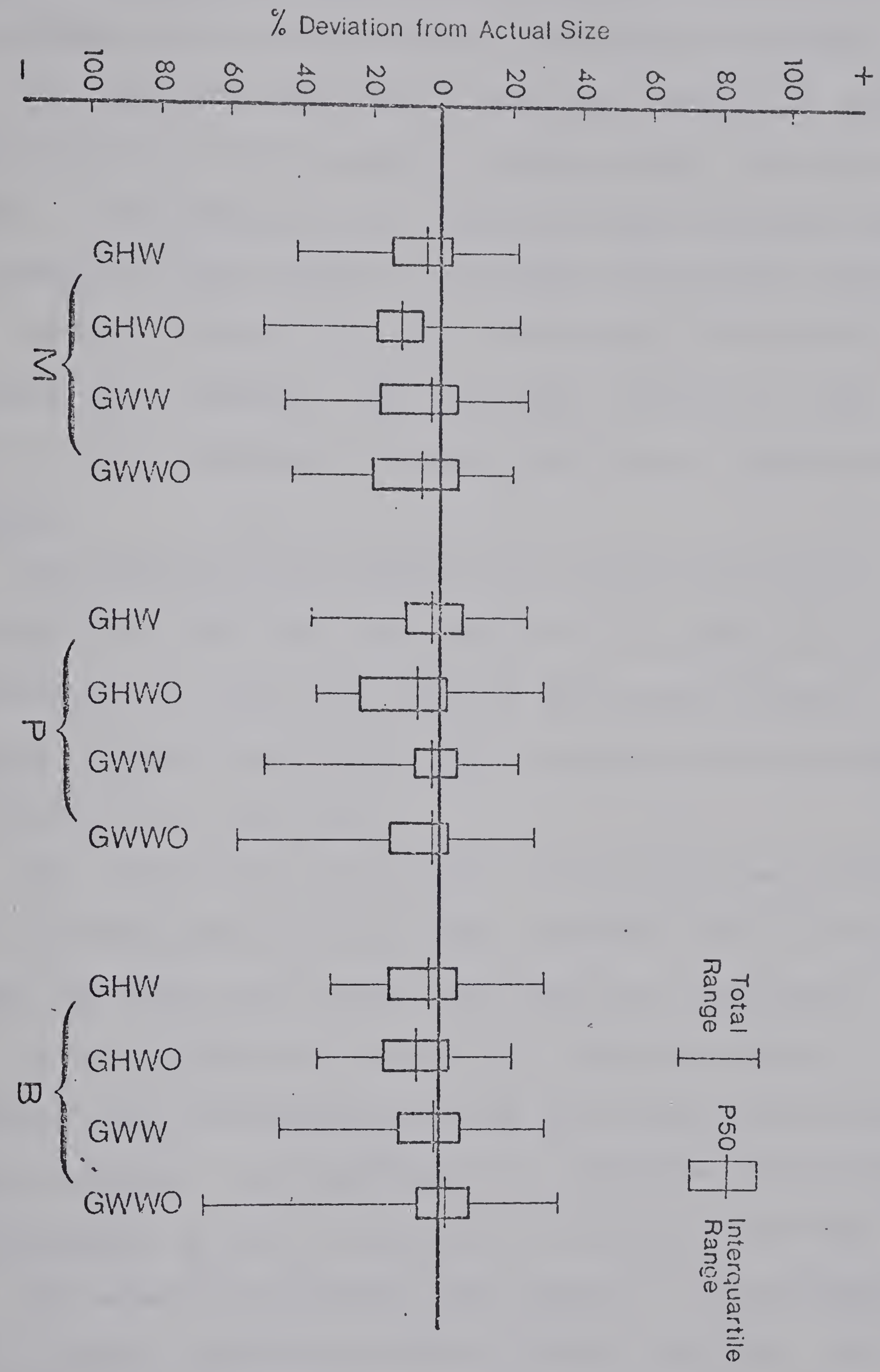
TABLE 5

SCORES, GOAL HEIGHT AND GOAL WIDTH

PERCENTAGE DEVIATION IN POSITIVE AND NEGATIVE DIRECTION FROM RGH AND RGW

P	MITES				PEEWEES				BANTAMS			
	Goal Height		Goal Width		Goal Height		Goal Width		Goal Height		Goal Width	
	W	WO	W	WO	W	WO	W	WO	W	WO	W	WO
1	23.7	23.0	26.0	21.5	35.2	35.7	22.9	28.9	30.8	23.0	32.0	37.5
25	3.19	-6.6	4.8	6.1	7.79	1.7	4.7	3.2	7.7	1.6	6.2	11.4
50	5.8	-11.5	-2.1	-5.6	3.9	-6.6	-1.3	-2.7	-3.9	-6.6	-1.3	1.95
75	-15.5	-17.2	-18.5	-19.7	-10.6	-22.2	-7.7	-13.7	-15.5	-15.1	-12.0	-6.6
99	-42.6	-54.2	-45.9	-42.6	-37.7	-34.5	-45.9	-56.9	-34.0	-34.5	-47.0	-85.3
PERCENTAGE OVERESTIMATION OF HEIGHT AND WIDTH AT 50th PERCENTILE												
50	5.8	11.5	2.1	5.6	3.9	6.6	1.3	2.7	3.9	6.6	1.3	-1.95*

*Underestimation



GRAPH 6.0

RANGES OF SCORES RELATING TO PERCEIVED GOAL SIZE SHOWN AS DEVIATION FROM ACTUAL SIZE

goal size when wearing full equipment. Medians for goal size without equipment show an overestimation of 12% by Mites closing to an underestimation of 1.95% by Bantams.

The important fact here is that the wearing of equipment results in a true perception of the height and width of the goal. This perception is distorted when equipment has been removed and the subject is wearing his lightest clothing.

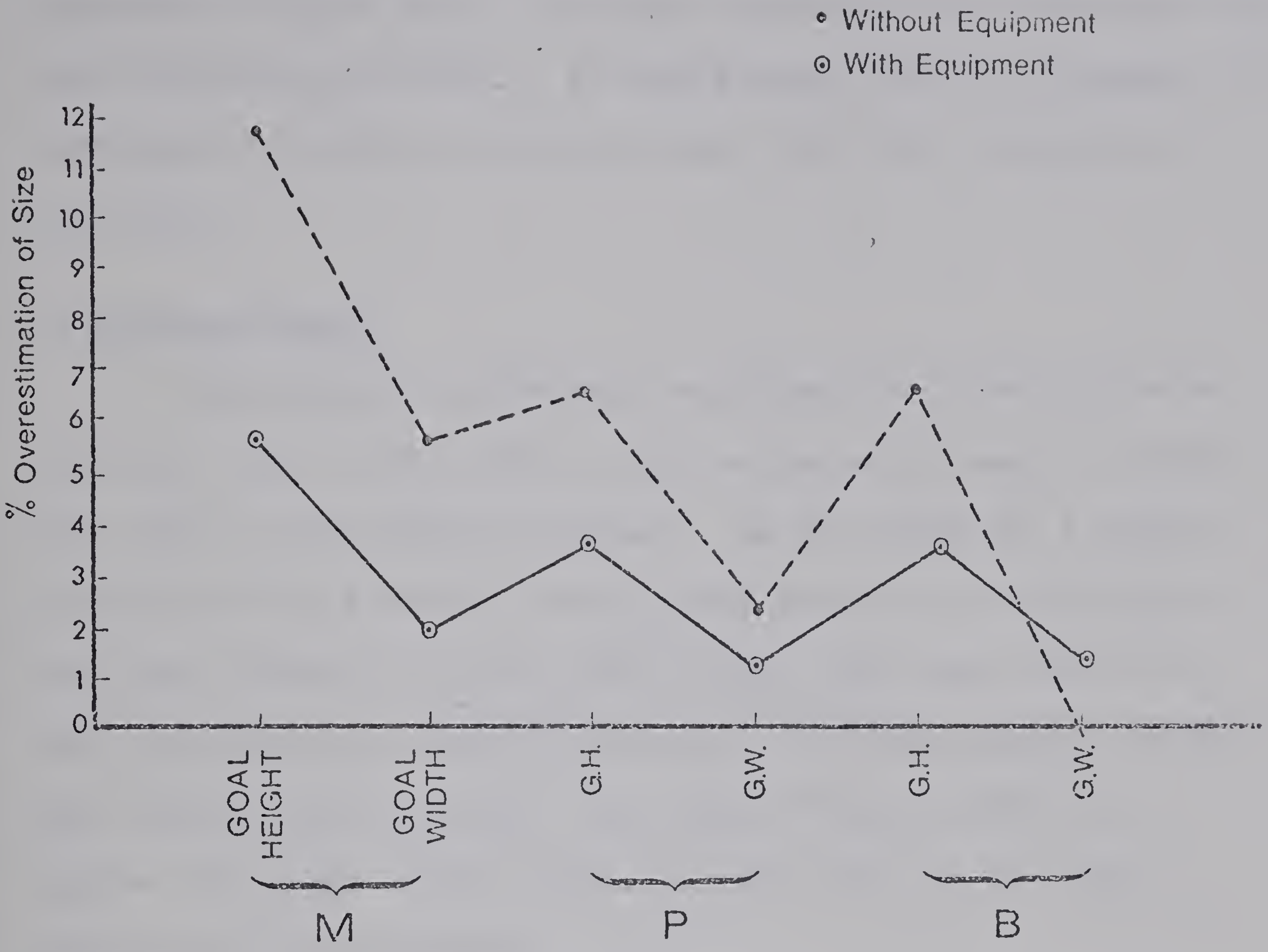
Graph 7.2 shows the scores for height and width at the 50th percentile (median). The estimates relating to the width of the goal are more accurate than those relating to the height.

The scores for the Bantams (the highest age group) are within 2% of the real size, both with equipment and without equipment. The Pee Wees show no difference between judgments of height and width, with equipment, also at under 2% deviation from real size.

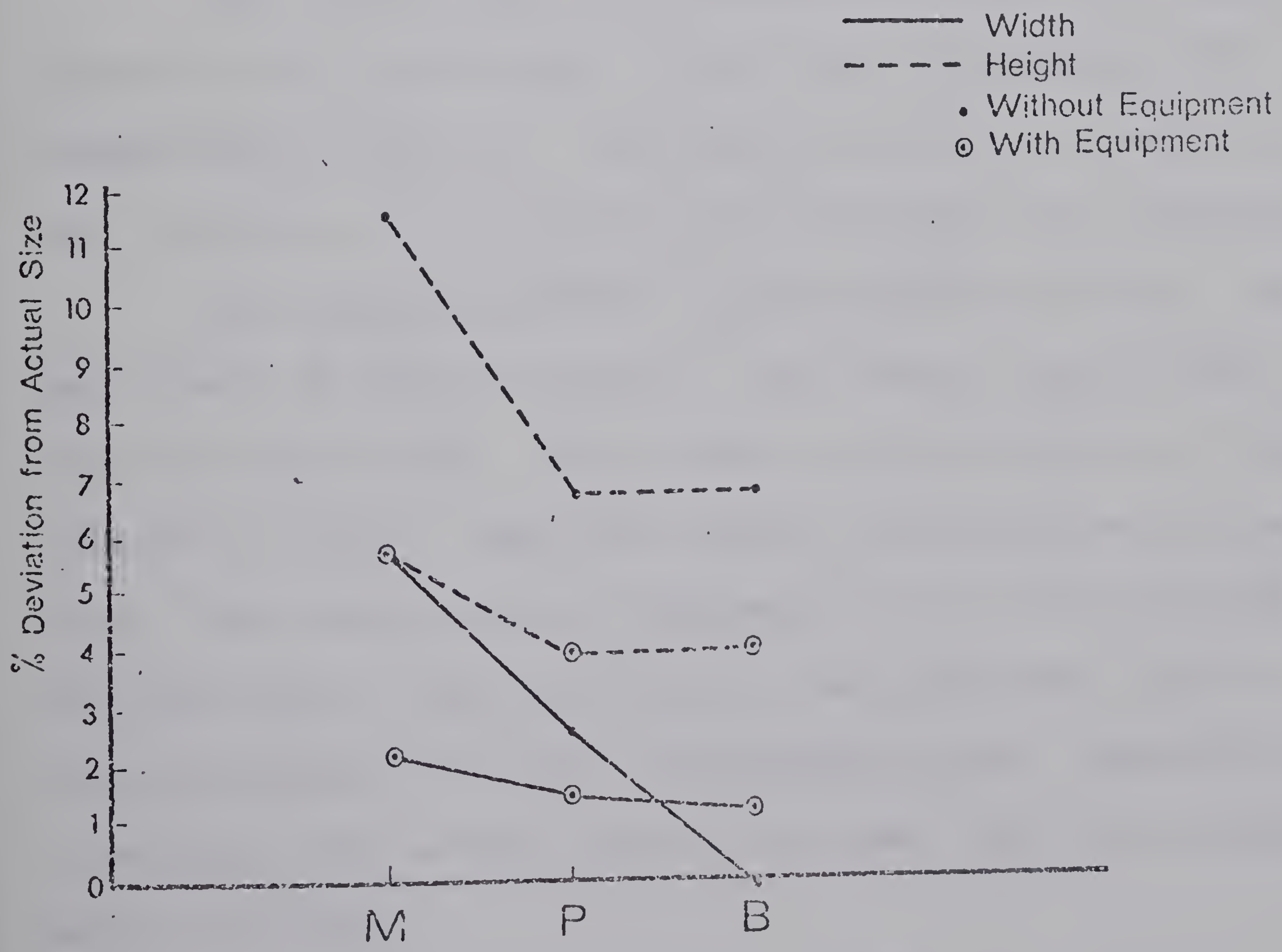
When estimating goal height, all groups show a minimum of 6.6% deviation from the real situation without equipment and the Mites and Bantams show 3-4% with equipment.

As in perception of body size, the goal tenders exaggerate their assessments of size when they remove their goaling equipment. The difference in judgments relative to goal dimensions is not so marked as in judgments of body size. When wearing equipment, the judgment of goal dimensions is almost accurate and varies little with age. The estimates do not reflect the change in age.

The removal of equipment does make a difference to



Graph 7.1: The effect of equipment on the estimation of goal size.



Graph 7.2: The difference in estimates for height and width at three age levels.

judgments of goal size, but this overestimation decreases as the subjects grow older. It would seem that the judgment of surrounding spatial context is more true than judgment of body size.

d) Blocking area.

The subject's attention was diverted from body size and goal size to the area of the net when he came to answer the task at the blocking device. As he looked at a representation of a standard goal he was required to visualize the space taken up by his body within that goal area. He then uncovered the area he believed to be equivalent to the area blocked by his body. By implication he must also assess the areas of the goal, to each side of the body, which are left unguarded.

The scores (BAW) are recorded in Table 5. They are expressed as a percentage of goal size (BAW/RGA x 100) and summarized in Graph 9. The range of scores increases as the age increases, but at P1 and P50 the scores are identical.

The standard SIPT(4) figure measures 7662 sq. cms. and blocks 34.4% of the goal. The median scores (BAW) in this test was 42.6%. This shows an overestimate of 8.2% in relation to SIPT. When the subject concentrates on the body size, (see section b), he estimates it to occupy 25-30% of the goal area. When he looks at the goal space (BAW) he believes himself to cover considerably more. Relating BAW to measures for actual size in the goal (PAW) he overestimates by 16-10%.

TABLE 6

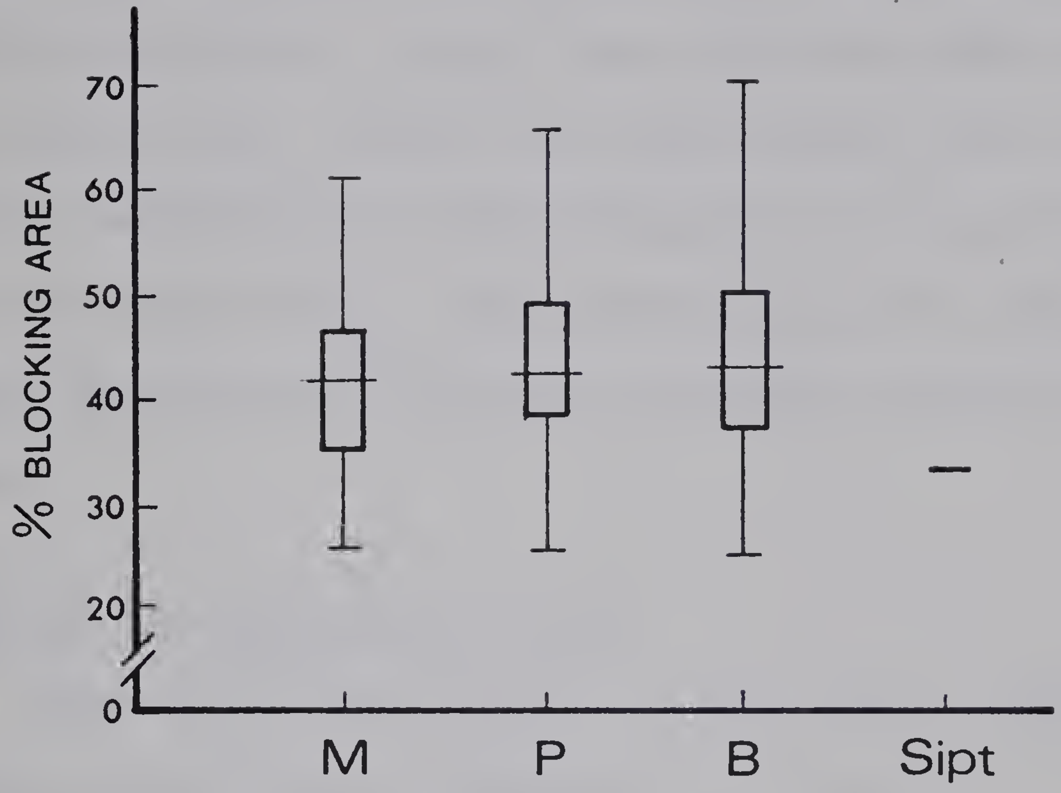
PERCENTAGE ESTIMATED AREA BLOCKED BY THE BODY

P	MITES	PEEWEES	BANTAMS
1	26.2	26.2	26.2
25	36.6	39.9	38.1
50	42.6	42.6	42.6
75	47.2	50.5	51.2
99	62.3	67.6	72.1

% Area Standard (Normal) SIPT(4) = 34.4%

Actual Blocking Area BAW:-
Mites p15 = 7607
Pee Wees p11 = 7461
Bantams p16 = 7607

SIPT(4) Area p = 7662



GRAPH 8.0

THE PERCENTAGE OF GOAL AREA BLOCKED BY THE BODY

(The relationship between PAW and SIPT(4) is discussed in section e).

The result indicates that the goaler underestimates the area he has to cover by 8% and in 50% of the cases by an even greater amount. Fewer than 16% Mites (P16 = 7607), 15% Pee Wees (P15 - 7607)[2] and 11% Bantams (P11 = 7461) correctly estimated or underestimated the area of the goal blocked by their body. When focussing on the body size, the majority misconceive the goal area which remains to be covered.

Discussion of sections b) to d).

Three different aspects of the size of the goaler have been described in sections b), c) and d).

In section b) the actual size of body area is compared with the size the goaler thinks himself to be. The procedure is replicated under two conditions; the goaler wearing full equipment and then wearing T-shirt and shorts. Furthermore it takes place in a strictly controlled environment, the goal. The second section, c), deals with the way the goaler sees the height and width of the goal, under the same two conditions. The open goal net is the focus of section d). Confronted with this, the subject is asked to make an estimate of the area of the net covered by the body. By implication he should also consider the areas at the sides of the goal, unguarded by the body. Thus the three foci are

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[2] SIPT(4) = 7662

body size, size of goal dimensions and goal area.

Results show that goalers aged eight to ten years, ten to twelve years and twelve to fourteen years overestimate their own size when wearing equipment and underestimate their own size without equipment. The judgment of goal dimensions, when wearing equipment is exact. The blocking area is very much exaggerated, although the goalposts, the limits of the area are accurately known. Therefore it seems that it is body size that is subject to error of estimation and this is increased when it is considered in relation to the area of the goal it covers.

The perceptual bias to overestimation of body size may be due to various factors, such as size, weight or awkward shape of the equipment. As it protects, it obstructs. The impediment to movement could be the main reason for the misjudgment of size. In the assembly of SIPT the glove arm, which is the most active part of the body, was the most accurately estimated. The suggestion is that difficulty in movement obscures body perception.

All scores increase in range and distance from the actual, when estimates are made without equipment. The erratic movement of scores relating to measures of a lightly clad boy in a situation in which he is accustomed to being well covered may in part be due to the testing situation. The rapid change of clothing, and the unusual situation of finding himself, in goal, wearing socks and shorts, may have accentuated his sense of inadequacy and vulnerability.

This could lead to an underestimation of size. As the literature has shown, perception of body size is related to confidence and power.

The estimation of the dimensions of the goal were accurate, when the reference was to the goaler in full equipment. Merleau-Ponty (1962) stresses that knowledge of space depends on inhabiting the space. It is the habit of the goaler to sweep the ice with his stick and touch the posts at his side. He constantly feels the bars with back and arms as he moves in and about the goal space. When the eyes and attention are directed forward the goal becomes better known by touch than by sight.

While completing the goal construction task, the goaltenders frequently referred to the body. They commented on the fact that when they stood upright the cross bar cut the back of the head and they estimated the distance of the goal posts from the body by spreading out their arms. Their knowledge appeared to be more tactile than visual and they referred to this when making a visual representation.

The fact that the goaler never sees himself in goal is relevant to what the subject was being asked to do in the goal blocking task. The goaler was required to look at himself in the goal area. He imagined himself to be covering a much greater area than in fact he did. This could be a measure of the area he believes he can successfully guard rather than a measure of size. He knows the goal through action, through success and failure, and it may be a total

body image he is representing rather than a mirror image.

In sum, the results show that the space the person inhabits is more accurately known than the body he inhabits. This study shows that the accuracy of perception of the immediate environment to some extent depends on being asked to make judgments in relation to the dress and behavior which is normal to the activity within the space. Within the familiar framework of the goal, the goaler consistently overestimates his own size in equipment and underestimates it without equipment. It is suggested that this distortion reflects the total experience concerning that particular space: that it is activity rather than cognition that determines his impression of himself in that context.

e) Perception of body size at different age levels.

Perception of body size was measured by SIPT tests in two ways: by the assembling of body parts and relating them to SIPT normal (4), and by relating the area of the SIPT man to the goal area determined by S.

The standard SIPT man (the number four body and parts), when completely assembled measured 7662 sq. cms. and represented 34.4% RGA (22296 sq. cms.). Standard SIPT was taken from the photograph of a fully grown man in a standard goal net (Horsky 1953).[3] He therefore probably

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[3] This figure was the only one found in the literature which illustrated the normal goal-tender. There are as yet no norms for goalers of younger age groups. A figure was needed that could be used for all age groups taking part in the major survey, including professional goal-tenders.

occupied a greater area of the goal net than a boy of ten, twelve or fourteen years of age. Boys of 10 are 78.8% of full height, 12 are 84.7% and 14 are 91.9% (Smart and Smart 1967). The median score for body area of Mites represented 77%, Pee Wees 87.2% and Bantams 93% of SIPT normal size. These relationships indicate that boys estimate their actual size in their cartographic representations (SIPT) with great accuracy. This is supported by the results of perceived and actual size as shown in Graphs 1 and 2.

In the choice of SIPT body parts, the boys slightly underestimated sizes in relation to normal, which confirms the assumption that they are accurately recording their own size. In this case, as in body size estimates the older age group was more accurate.

The tests relating to perceived body size to actual size also reflect the changes due to growth. The curves of scores (Graph 5) relating to estimates (actual : perceived) parallel each other through the age ranges.

In the perception of goal height and width, with equipment, the scores did not vary between age groups. The same was true for the blocking device scores, which were dependent on a judgment of width. Thus in judging their own body size the boys reflected their own changing size, but in judging a constant size no age difference is noted.

There is a difference between the age groups where scores represent estimates without equipment. The range of scores here increases considerably with increasing age,

though at all times the interquartile range more nearly approaches the actual size with the older boys.

The results justify Gunvald's claim for the validity of the "disassembled manikin" method, in that the instrument SIPT reflected expected growth patterns within the age groups. Generally, Witkin's theory (1962) that a more articulated body image emerges with increase in age is confirmed.

CHAPTER V

SUMMARY AND CONCLUSIONS

One aspect of ice hockey goaling is analysed in this study. The purpose of the study was to find the effect of wearing heavy equipment on the goaler's perception of the relationship between his body size and the goal size. The objectives were threefold: to measure the goaler's perception of his body size, including the sizes of separate body parts, to measure his perception of the dimensions of the goal and to measure the area of the goal he thinks he blocks with his body.

Three tests were designed to measure perception of body size and goal size. The Self-Image Perception Test (SIPT) measured the relationship between body parts, and the total size the goal tender perceived himself to be. The goal construction task measured perception of height and width of the goal. The blocking device measured the area of the goal blocked by the body of the goaler.

The effect of equipment on perception was obtained by comparing results of the tests which were taken by the goaler in his equipment and without his equipment.

The goaler's perception of the relationship between body and goal was compared to his actual size in a standard goal. This was obtained by photographing the goaler, in the goal, both in his equipment and without equipment.

All tests were replicated at three different age levels; eight to ten years, ten to twelve years and twelve to fourteen years, and the findings related to growth patterns.

The results of the study show that the goaler overestimates his own size compared with his actual size when he is wearing full equipment and underestimates when he stands in the goal without equipment. He correctly perceives the goal height and goal width when wearing goal tending equipment but his perception becomes slightly distorted when equipment is removed.

He overestimates the area of the goal blocked by his body. He thinks he occupies approximately forty-three per cent of the goal area on average. The actual area is twenty-three per cent to thirty-two per cent depending on age.

The goal tenders generally overestimated the size of the head and underestimated the size of the stick hand. Their estimates of other body parts followed their growth patterns as measured by the photographs. In all tests of actual and perceived body size normal growth patterns were reflected in the scores.

Conclusions

On the basis of results obtained in this study it appears that the wearing of heavy equipment can affect judgment of body size. An overestimation would imply an underestimation of the goal area to be covered by the goaler.

Therefore the conclusion is that goalers may not have an accurate knowledge of their task in that many of them do not appear to have a realistic idea of the true relationship between their body size and the goal size.

It would seem that the goaler's perception of body size is biased by his body image more than by any visual image he may have of his own body. The body image includes the knowledge gained through experience of activity, skill, success and failure as a goaler which contribute to his impression of his body in the goal. This includes his perception of body parts which seen to be affected by their use and importance.

The goaler's estimates of the goal he occupies are realistic provided that he retains the dress and behavior to which he is accustomed in the particular situation. If this changes, his perception of the environment changes also. Accuracy seems to depend on the familiarity of the experienced relationship between behavior and context.

The literature suggests that tools, instruments and perhaps equipment blend into the body image. If it is general that people overestimate their size in confined spatial conditions, there are important implications for activities and industries that require the use of heavy protective clothing.

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APPENDIX A

AGE-GROUP GOALIE STUDY

GR-WILBERG, RB - #5532610

GOALIE FORM

NUMBER: 0216 (1 2 3 4) GROUP: (5) COMMUNITY: (6 7 8 9 10 11 12 13 14 15)

NAME: (16 17 18 19 20 21 22 23 24 25 26 27) INITIALS (28 29) DATE OF BIRTH: YEAR (30 31) MON. (32 33) DAY (34 35)

WEIGHT: (36 37 38) Kg. HEIGHT: (39 40 41) Cms.

WINS: (42 43) LOSSESS: (44 45) APPROX. GOAL AVERAGE: (46 47)

GOALIE ESTIMATE WITH EQUIPMENT

BODY: (48) GLOVE ARM: (49) STICK ARM: (50) STICK: (51) LEGS: (52) HEAD: (53)

GOAL HEIGHT: (54 55 56) GOAL WIDTH: (57 58 59) BLOCKING AREA: (60 61 62 63)

GOALIE ESTIMATE NO EQUIPMENT

BODY: (64) GOAL HEIGHT: (65 66 67) GOAL WIDTH: (68 69 70)

PHOTO AREA

WITH EQUIPMENT: (71 72 73 74 75) NO EQUIPMENT: (76 77 78 79 80)

APPENDIX B

SIPT CODE

SIPT PARTS	SIZES OF SIPT PARTS						
	1	2	3	4	5	6	7
GLOVE ARM	35	19	26	4	9	36	41
STICK ARM	40	29	15	10	3	27	38
STICK	1	34	22	21	39	12	13
LEGS	7	17	30	37	24	6	31
HEAD	28	2	11	33	20	14	23
% HEIGHT	-21	-14	-7	N	+7	+14	+21
BODY				25			

APPENDIX C

APPENDIX C

CALCULATION SIPT RATIO

1. To equate perceived size to real life size.

Photographic size of standard goal = real life size.

Horsky man in his standard goal enlarged to photographic size:

Horsky man area then 1189 square 1/10"

SIPT(4) man area 3758 square 1/10"

To equate SIPT:HORSKY, ratio = $\frac{1189}{3758}$

= .3164

To equate SIPT dimensions to Horsky, ratio = .3164

= .562

2. To equate perceived goal dimensions without equipment: with equipment. i.e. to reduce SIPTO : SIPT (Horsky size)

SIPTO reduced in size to fit photographic goal.

Height Horsky man = 12.7 cm.

Height SIPTO = 11.8 cm.

Therefore SIPTO goal dimensions must be reduced $\frac{118}{127}$

= .929

Goal area GAWO must be reduced $(.929)^2$

= .86

APPENDIX D

TABLE 7

SIPT BODY PARTS

FREQUENCIES, PERCENTAGE FREQUENCIES AND PERCENTILES

BODY PART			MITES			PEEWEES			BANTAMS		
Name	No.	Area	f	%f	P	f	%f	P	f	%f	P
Glove Arm	1	218.42	11	22	1	8	13.3	1	6	10.9	1
	2	263.33	8	16	25	8	13.3	25	6	10.9	
	3	289.86	12	24	50	15	25.0	50	11	20.0	25
	4	347.10	11	22	75	7	11.6		11	20.0	50
	5	371.51	5	10		15	25.0	75	15	27.0	75
	6	471.54	3	6	99	5	8.3	99	4	7.27	
	7	491.95	0	0		2	3.3		2	3.6	99
Stick Arm	1	508.28	33	66	50,1,25	28	46.6	1,25	18	32.7	1,25
	2	638.92	4	8		12	20.0	50	12	21.8	50
	3	661.38	8	16	75	8	13.3	75	13	23.6	75
	4	806.31	4	8		6	10.0		6	10.9	
	5	910.41	0	0		4	6.6		3	5.5	
	6	996.15	1	2	99	2	3.3	99	2	3.6	
	7	1155.36	0	0		0	0		1	1.8	99
Stick	1	612.39	20	40	1,25	9	15.0	1	5	9.1	1
	2	814.45	7	14	50	10	16.6	25	12	21.8	25
	3	838.71	11	22	75	10	16.6		6	10.9	
	4	1000.23	4	8		13	21.6	50	11	20.0	50
	5	1139.03	3	6	75	10	16.6	75	9	16.4	75
	6	1314.59	5	10	99	7	11.6	99	10	18.2	
	7	1481.97	0	0		1	1.6		2	3.6	99
Legs	1	1522.8	8	16	1	5	8.3	1	2	3.6	1
	2	1941.26	13	26	25	8	13.3		6	10.9	
	3	1992.29	12	24	50	17	28.3	25	12	21.8	25
	4	2386.26	9	18	75	14	23.3	50	13	36.4	50
	5	2776.14	6	12		13	21.6	75	14	25.5	75
	6	3084.38	1	2		3	5.0	99	7	12.7	
	7	3525.30	1	2	99	0	0		1	1.8	99
Head	1	198.01	0	0		0	0		0	0	
	2	236.79	7	14	1	4	6.6	1	4	7.3	1
	3	257.20	7	14	25	1	1.6		2	3.6	
	4	312.32	7	14		11	18.3	25	10	18.1	25
	5	342.94	14	28	50	14	23.3		14	25.4	50
	6	375.6	8	16	75	16	26.6	50	9	16.4	
	7	428.64	7	14	99	14	23.3	99,75	16	29.1	75,99

Constant Body Size = 2819.

TABLE 8

BODY AREAS AND GOAL AREAS

BODY AREAS

P	MITES			PEEWEES			BANTAMS		
	PAWO	PAW	SIPT	PAWO	PAW	SIPT	PAWO	PAW	SIPT
1	2291	3875	5917	2578	4490	5692	2715	4758	6411
25	2733	4501	6487	3353	5695	6746	3772	6109	7028
50	3014	4783	6873	3628	6086	7320	4002	6505	7479
75	3393	5184	7320	3973	6442	7656	4404	7160	8293
99	4191	7378	8581	4444	6878	9048	5104	8090	9197

GOAL AREAS

P	MITES		PEEWEES		BANTAMS	
	GAWO	GAW	GAWO	GAW	GAWO	GAW
1	15074	14402	10186	11496	12548	13202
25	22409	20561	19964	20403	19991	19898
50	25804	24493	24446	22748	23631	24122
75	30720	29183	28520	27091	27162	28299
99	43921	44060	38706	45007	40607	41407

TABLE 9

SCORES, GOAL HEIGHT AND GOAL WIDTH

P	MITES				PEEWEES				BANTAMS			
	Goal Height		Goal Width		Goal Height		Goal Width		Goal Height		Goal Width	
	W	WO	W	WO	W	WO	W	WO	W	WO	W	WO
1	93	93.8	135	144	79	78.3	141	130	84	94	124	114
25	118	130	174	172	112	120	174	177	112	114	171	162
50	129	136	188	193	126	130	185	188	126	130	185	179
75	140	143	217	219	137	149	197	208	141	140	205	195
99	174	188	267	261	168	164	267	287	163	164	270	339
	Deviation From RGH (121.92) and RGW (182.88)											
1	29.0	28.1	48.0	39.4	43.0	43.62	42.0	52.88	37.6	28.12	59.0	68.58
25	3.9	-8.08	8.6	11.08	9.5	2.12	8.6	5.88	9.5	1.92	11.5	20.88
50	-4.5 -7.1	-14.08	-5.1	-10.2	-7.7 -4.8	-8.08	-2.5	-5.12	-4.58	-8.08	-2.5	3.58
75	-18.0	-21.08	-34.0	-36.12	-13.0	-27.08	-14.0	-25.12	-1.9	-18.4	-22.0	-12.12
99	-52.0	-66.08	-84.0	-78.0	-46.0	-42.08	-84.0	-104.1	-41.0	-14.08	-86.0	-15.6

TABLE 10

ESTIMATED AREA BLOCKED BY THE BODY (BAW)

P	MITES	PEEWEES	BANTAMS
1	5852	5852	5852
25	8046	8913	8485
50	9509	9502	9509
75	10533	11269	11411
99	13898	15069	16093

B30101